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Contents

EDITORIAL

Dear Readers,

On behalf of the Editorial Board of the Q Bulletin, I am glad to present Volume 1, Number 31 of the journal, which is the fourth series of the new Q Bulletin. Established in 2019, this new Q Bulletin has been viewed by 5492 and downloaded by 543 users as recorded in MyJurnal (cumulative data from 23 Feb 2021 until 11 Oct 2022). These are promising signs that the journal has reached its potential readers and contributors.

Four of the five manuscripts in this issue are in the discipline of pharmacy. I must congratulate the Pharmaceutical Services Programme for this achievement. Pharmacy-related projects have been the major contributor to the Q Bulletin since its initial edition. This time, two initiatives were carried out in health clinics, while the other two were implemented in hospitals.

In conjunction with the 11th National QA Convention 2022, we also successfully released a supplementary issue consisting of 58 abstracts of the projects presented and competed in the convention, which was held in Penang from 4-6 October 2022. Hats off to the authors and our heartiest appreciation to the reviewers and editors' team who had made an effort to bring out the issue and print in the scheduled time before the convention. You can check this at https://qaconvention.nih.gov.my/abstract or https://tinyurl.com/QBulletinSupplementary.

Let me take this opportunity to thank our existing external reviewers and welcome the new ones on board to be part of the Q Bulletin family. Most of our external reviewers are clinicians or front liners with experience in conducting quality improvement studies; in other words, they are Quality Champions in their own fields. We highly appreciate their contributions to add value to the manuscripts which the internal reviewers might have missed/overlooked. On the other side, we hope that your appointment as the Q Bulletin's external reviewer will help you hone your review abilities and enhance your CV.

Dr Samsiah Awang
Editor-in-Chief

REDUCING THE PERCENTAGE OF FLOOR STOCK MEDICATIONS WITH EXCESSIVE QUANTITY IN THE EMERGENCY AND TRAUMA DEPARTMENT, PORT DICKSON HOSPITAL

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Abstract

It is crucial to keep a sufficient amount of safe, unexpired and necessary floor stock medications in the Emergency and Trauma Department (ETD) at all times to deliver timely patient care. However, medication stockpiling or inappropriate accumulation of medication is common and has been shown to cause medication wastage, ineffective treatment or toxic effects due to the medication's expiration. In Port Dickson Hospital, the ETD contributed to 26.1% and 67.7% of floor stock medications with excessive quantity out of all units and wards in 2018 and 2019, respectively. Hence, this quality improvement study aimed to achieve a 50% reduction in floor stock medications with excessive quantity in the ETD of Port Dickson Hospital from the baseline of 11.2% over an approximately one-year duration. A self-administered survey form was distributed among 40 doctors, pharmacy staff, staff nurses and medical assistants to identify the contributing factors. The main contributing factors identified were inefficient management and supervision, non-adherence to standard operating procedures (SOPs) and improper stock management in the ETD. The remedial measures undertaken to solve the problems included appointing an emergency physician, a chief nurse, a chief medical assistant and an in-patient pharmacist to be responsible for stock issues; revising the indent form; reorganising the medication storage area; providing medication storage conditions by the pharmacy department to the ETD staff; reminding medical assistants to return excessive or near expiry medications monthly; reinforcing SOPs on documentation and counter-checking. After five study cycles, the interventions reduced the percentage of floor stock medications with excessive quantity from 11.2% to 1%. Efforts have been made to replicate the remedial measures used in this study in other units and wards, and continuous monitoring is necessary to ensure the effects can be sustained in the long term.

KEYWORDS: Stock management, Excessive medication, Expired medication, Quality improvement

Problem

The Emergency and Trauma Department (ETD) is a hospital's first point of contact to provide timely patient care to those with acute illnesses and injuries (1). In order to deliver immediate healthcare services, it is crucial to keep a sufficient amount of safe, unexpired and necessary floor stock medications in the ETD at all times. However, medication stockpiling or inappropriate accumulation of medication is common and has been shown to cause medication wastage, ineffective treatment or toxic effects due to the medication's expiration (2).

Floor stock medications refer to bulk medications placed in the drug room of the nursing unit (3). Having floor stock medications enable nurses or other medical staff to access the medicines faster without going through an in-patient pharmacy (3). Although floor stock medications are convenient to ward personnel, related problems such as improper medication stockpiling, spoilage, expiration or other storage issues are common. Therefore, regular stock inspection is required in every unit or ward to monitor and ensure the floor stock medications are managed in accordance with the logistics pharmacy management and in-patient pharmacy drug supply guidelines (4,5). For hospitals in Malaysia, pharmacists will conduct ward or unit inspections at least three times a year to ensure the number of medications kept in the ward or unit is in good condition, clean and adequate (5).

In Port Dickson Hospital, previous ward inspection reports showed that the ETD contributed to 26.1% (MYR843.94≈USD209.09) and 67.7% (MYR3,660.70≈USD884.06) of floor stock medications with excessive quantity out of all units or wards in 2018 and 2019, respectively. A verification study conducted from October to November 2019 reported that the ETD topped the list with 11.2% of floor stock medications with excessive quantity, which was reflected by the unsatisfactory ward inspection of the department, lingering between grade C (70-80%) and grade D (<70%) throughout the years. Most of the time, these excessive floor stock medications will be expired or spoiled before being utilised.

This study was conducted in the Pharmacy Department and the ETD of Port Dickson Hospital. Port Dickson Hospital is one of the leading hospitals caring for an estimated 1.13 million population in Negeri Sembilan, Peninsular Malaysia (6). During the study period, there were three emergency physicians, 20 medical officers, 32 medical assistants, 11 staff nurses and 32 supporting staff serving the ETD. The medical officers and specialists in the ETD attend to approximately 1,500 to 2,000 patients and prescribe about the same number of prescriptions every month. With a high volume of patient visits, approximately 100 types of floor stock medications were kept in the unit: 20.2% for blood and blood-forming organs, 15.4% for the nervous system, 12.5% anti-infectives for systemic use, 9.6% for alimentary tract and metabolism, and 8.7% for the respiratory system, among others. The majority (63.5%) of the medications were injectables. There were 42 staff working in the Pharmacy Department, including 23 pharmacists, six pharmacy assistants and 13 supporting staff. The in-patient pharmacy is responsible for consistently supplying floor stock medications to all units and wards, as well as monitoring their stock levels every four months through ward inspection.

Although the verification study showed that the ETD had only 11.2% of floor stock medications with excessive quantity, it could still impact patient safety, as well as cause medication error and cost wastage. Therefore, the general objective of this study was to achieve a 50% reduction in floor stock medications with excessive quantity in the ETD from the baseline of 11.2% over approximately a one-year duration.

Background

Excessive floor stock medications has always been a concern in the health care system due to its significant impacts. For example, in 2015, Malaysian Auditor General's Report highlighted that one of the hospitals in Malaysia had wasted MYR308,373

(≈USD78,983) due to unused medicinal drugs (7). In addition, a study done by Lee et al. (2) showed that approximately 28% of the floor stock medications were returned to the pharmacy department because they were excessive in quantity, with some being expired. Therefore, good stock management is necessary to keep costs down, ensure good patient care and prevent mistakes or fraud (8).

According to Aziz et al. (9), unnecessary disposal of drugs stored in the ward can be attributed to three significant factors: ward personnel do not check the stock level, inadequate checking on the drug received and not practising the principle of First-In-First-Out (FIFO). Papalexi et al. (10) identified that the root cause of medication wastage stemmed from a few factors. Firstly, some procedures were not carried out as they should have, e.g., stock checks were not done by pharmacists, leading to medications expiring unknowingly. Secondly, ward personnel ordered higher medication quantities than needed, i.e., practice unnecessary stock holding. Thirdly, poor communication between the stakeholders leads to increased wastage.

A few strategies are available to solve the problems related to inventory management and stock control. Firstly, leaders or supply managers must inspire and guide the staff on proper inventory control (11,12). Secondly, an updated standard list of stock items needs to be maintained as it is crucial to keep the stock in check (11,12). Thirdly, the relevant ward can practise the principle of FIFO and ensure timely disposal of slow-moving or overstocked items to avoid items expiring before utilisation (12). This can be done by applying lean philosophy, enabling pharmacists to manage their stock correctly and eliminate waste (10). Besides, seminars and facilitated workshops should be organised to address excessive stock holding issues and encourage communication between pharmacists and doctors (10,12).

Moreover, automated drug dispensing cabinets (ADCs) were introduced to improve medication delivery (13,14). This equipment has been proven to be able to reduce the weekly stockout percentage, improve the average medication turnaround time and reduce potential product expiration (13). Besides that, higher user satisfaction and reduced medication process errors were reported with the application of ADCs (14). This technology is currently available in certain private and teaching hospitals in Malaysia.

Measurement

This quality improvement study was conducted from October 2019 to November 2021. The floor stock medications with excessive quantities detected by pharmacists during ward inspection were included in this study. Patient-own-medicines (POMs), medications prescribed to the patients in the ETD but were not on the floor stock list, and excessive medications that have already been recorded and kept aside to be returned to the Pharmacy Department were excluded from this study. The percentage of floor stock medications with excessive quantity in the ETD was used as the indicator for improvement. The percentage was calculated using the formula below:

$$\textit{Percentage of floor stock medications with excessive quantity in the ETD} = \frac{\textit{Number of medications with excessive quantity detected during ward inspection}}{\textit{Total number of medications in the floor stock list}} \; X\,100\%$$

For example, if ipratropium nebulising solutions, captopril 25mg tablet and metoclopramide 10mg ampoule were detected to have excessive quantities of 10 respules, five tablets and three bottles, respectively, during ward inspection, the number of floor stock medications with excessive quantities will be counted as 3, irrespective of the total amount of the excessive medications. The standard was set at 5.6%, which was a 50% reduction from the baseline of 11.2% in the verification study, as adopted by Lee et al. (2019) (2) and agreed upon in the cross-departmental meeting between the head of the Pharmacy Department and ETD.

Data for the indicator were retrieved from the ETD ward inspection reports throughout the study period. For example, the list of floor stock medications with excessive quantities, together with the expired medications and the costs involved, were identified from the reports. In addition, the indent forms (refer to Appendix 1) sent from the ETD to the Pharmacy Department were checked to extract data on the critical

steps of indenting and supplying floor stock medications.

Initial Assessment of the Problem

Several sessions were conducted to brainstorm the factors leading to excessive floor stock medications in the ETD. Subsequently, a set of a questionnaire consisting of 15 items was designed and distributed to 40 doctors, pharmacy staff, medical assistants and nurses in the Pharmacy Department and the ETD to collect their opinion regarding the contributing factors to excessive floor stock medications. Data collected from the survey were converted into a Pareto chart to determine the major contributing factors. Based on the Pareto principle, three primary factors were identified: inefficient management and supervision (26.8%), non-adherence to standard operating procedures (SOP) (24.7%) and improper stock management in the ETD (21.3%), which collectively contributed to around 80% of all the contributing factors (15). The details are shown in Table 1 and Figure 1.

Table 1: Factors leading to excessive floor stock medications in the Emergency and Trauma Department

Factor	n (%) [a]
A. Inefficient management and supervision	
1. Poor dissemination of information regarding ward inspection results to all ETD staff	18 (28.6)
2. No designated personnel to oversee stock issue in the ETD	15 (23.8)
3. Insufficient ward inspection by the Pharmacy Department	13 (20.6)
4. No feedback from the ETD to the Pharmacy Department after each ward inspection	9 (14.3)
5. Outdated floor stock indent form	8 (12.7)
TOTAL	63 (100)
B. Non-adherence to SOP	
1. No returning of extra or expired medications from the ETD to the Pharmacy Department	16 (27.6)
2. Over indent floor stock medications by the ETD	16 (27.6)
3. Lack of counter-checking process from both departments	14 (24.1)
4. Oversupply of floor stock medications by the Pharmacy Department	12 (20.7)
TOTAL	58 (100)
C. Improper stock management in the ETD	
1. Improper storage space	27 (54.0)
2. Over-storage of unneeded medications	23 (46.0)
TOTAL	50 (100)
D. Inexperienced staff	
1. No reward mechanism	21 (55.3)
2. Lack of awareness	17 (44.7)
TOTAL	38 (100)
E. Inconsistent drug usage pattern	
1. Unpredictable types of cases	16 (61.5)
2. Different prescribing habits	10 (38.5)
TOTAL	26 (100)

[a] *n = number of responses*

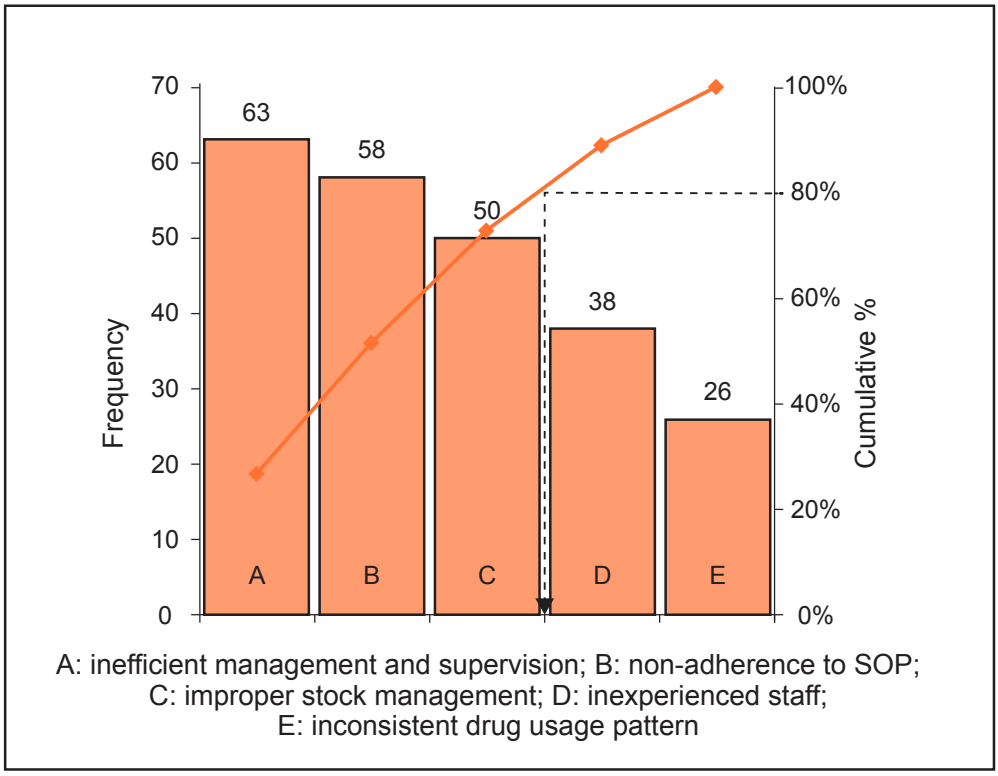

Figure 1: Contributing factors to excessive floor stock medications in the Emergency and Trauma Department

Apart from the questionnaires, the floor stock medication indent forms and ward inspection reports from the ETD throughout the study period were reviewed in this study. Two team members collected and analysed all indent forms sent to the Pharmacy Department one month before the ward inspection. For example, if ward inspections were scheduled in March, the floor stock medication indent forms sent to the pharmacy in February were collected and analysed. Subsequently, the data were counter-checked by the other team members.

The current process of care involving indenting and supplying floor stock medications was also reviewed to identify the critical steps for improvement. The critical steps in indenting floor stock medications included checking and recording stock balance in the floor stock medication indent forms, receiving medications from the in-patient pharmacy and storing medications. The verification study showed that more than half (57.7%, n=15) of the reviewed floor stock medication indent forms (n=26) did not have stock balance recorded and 42.3% (n=11) were not completed with signatures during the medication indenting process. In addition, when receiving supplies from the in-patient pharmacy, 30.8% (n=8) of the ETD staff did not check the supplies nor sign the indent forms. During ward inspection, it was also found that some medications were not stored in the correct container or at the proper temperature. For instance, paracetamol suppositories that were supposed to be stored at room temperature were wrongly stored in the refrigerator. Therefore, proper medication storage was included as one of the critical steps in this study. Nonetheless, 98% (96 out of 98) of the floor stock medications checked during the verification study were stored in the correct container and at the correct temperature. Noteworthily, some medications were found expired during ward inspection as the First Expired, First Out (FEFO) concept was not applied. However, 97 out of 98 (99%) floor stock medications checked during the verification study were not expired. In short, due to irregular shifts, heavy workloads and shortages in the workforce, the balance of floor stock medications was not adequately checked and recorded by medical assistants before the indenting process. The same

factors might have also led to the lack of counter-checking and improper storage of floor stock medications after receiving them from the pharmacy.

On the other hand, critical steps involving the Pharmacy Department included ensuring the indent forms were completed with the stock balance in the ETD and the signature of the ETD staff, counter-checking the number of medications supplied to the ETD and signing the indent forms. The verification study reported that out of the total indent forms (n=26) received by the pharmacy staff, 53.8% (n=14) were without recorded balance and 42.3% (n=11) were without ETD staff's signatures. Besides, 53.8% (n=14) of the indent forms were not counter-checked nor signed by the pharmacy staff. Due to the lack of awareness among new staff and shortage of the workforce on certain days, e.g., public holidays and weekends, the balance of floor stock medications in the ETD and the quantity of the medications supplied might not have been checked by the pharmacist upon the supplying process. The process of care is shown in Figure 2. The verification study result is shown in Table 2.

Strategy

Following the identification of the contributing factors, a total of six remedial actions or strategies were implemented in this study. The first two strategies were implemented from February to July 2020 (Cycle 1), another two strategies were implemented from August to November 2020 (Cycle 2), and the last two strategies were implemented from December 2020 to March 2021 (Cycle 3). The effects of the strategies were re-evaluated two times from June to July 2021 (Cycle 4) and from October to November 2021 (Cycle 5).

Cycle 1 focused on tackling the issue of inefficient management and supervision. Before this quality improvement study, there was no designated personnel for stock management in the ETD. There was also inadequate dissemination of ward inspection reports among the ETD staff and no feedback was collected from the ETD staff after each ward inspection, leading to persistent mistakes in managing floor stock medications. Hence, one of the strategies was to appoint an ETD specialist, a chief medical assistant and a chief nurse to oversee stock issues in the ETD and update the in-patient pharmacist-in-charge via email on the improvement made within one month after each ward inspection. This strategy can ensure that the person-in-charge (PIC) knows about the latest condition of floor stock medications, provides timely corrections and prevents repetitive mistakes. The second strategy implemented in Cycle 1 involved revising the outdated floor stock medication indent form, which had caused unnecessary indent of slow-moving and unnecessary items. Before this study, the indent form was seldomly revised and would only be updated upon request. In Cycle 1, the indent form was updated after discussing with the ETD PIC and the in-patient pharmacist to remove infrequently used items and adjust the amount required for other medications. Besides, an agreement was reached between both parties that the indent form shall be revised at least once a year. The indent form was revised three times throughout the study period. The remedial actions implemented in Cycle 1 resulted in a 0.8% reduction of achievable benefits not achieved (ABNA).

In Cycle 2, strategies were developed to improve existing floor stock medication management in the ETD. Before this study, the same floor stock medications were kept in a few places, leading to excessive indenting as the ETD staff was unaware that the medications were available in other areas. Therefore, discussions were held between the in-patient pharmacist and the ETD PIC to reorganise the storage area to accommodate more floor stock medications so that all the medications can be stored in one single storage area. This strategy will also enable the ETD PIC to monitor floor stock levels more effectively. In addition, the Pharmacy Department developed two new guidelines, i.e., a list of medications that shall be kept in the refrigerator and an Injectable Drugs Guide for Adult Patients to facilitate the ETD

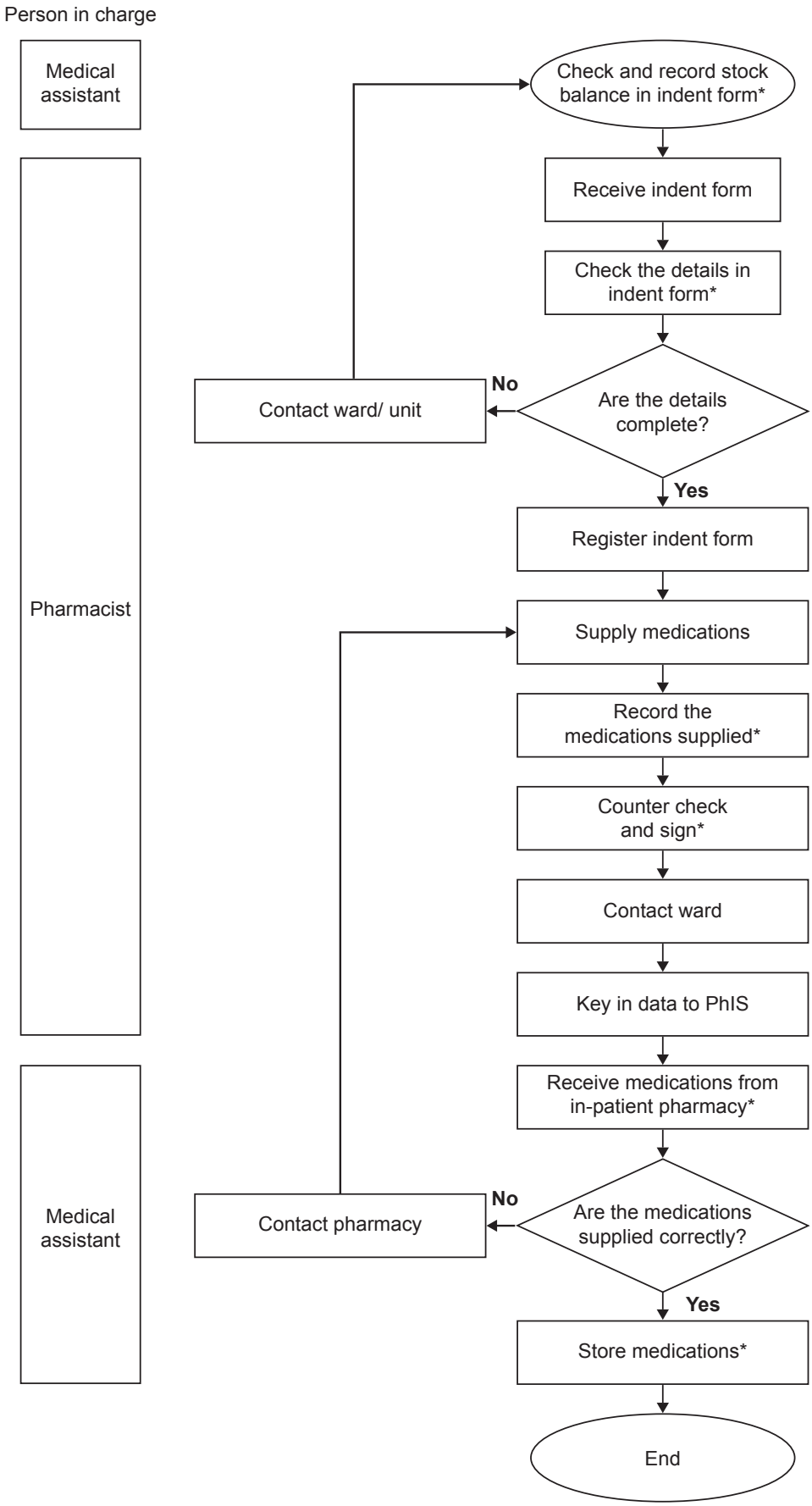

Figure 2: Process of care for indenting and supplying floor stock medications (* indicates critical steps)

Note:
PhIS: Pharmacy Information System

Table 2: Critical steps in indenting and supplying floor stock medications by the Emergency and Trauma Department and the Pharmacy Department

Step	Process	Criteria	Standard	Verification Study	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 5
Indenting (by the Emergency and Trauma Department)									
1.	Check and record stock balance in indent form	• Prepare indent form in duplicate	100%	100%	100%	100%	100%	100%	100%
		• Record current stock balance	100%	42.3%	16.7%	25%	60%	66.7%	69%
		• Indent quantity not more than the maximum allowable amount	100%	92.3%	91.7%	100%	84%	100%	100%
		• Sign the indent form	100%	57.7%	100%	96.4%	100%	100%	100%
		• Record usage of list A items	100%	92.3%	100%	100%	100%	100%	100%
2.	Receive medications from an in-patient pharmacy	• Check the quantity supplied	100%	69.2%	100%	92.9%	100%	93.9%	96.6%
		• Sign the indent form	100%	69.2%	100%	92.9%	100%	93.9%	96.6%
3.	Store medications	• Stock medications at designated places (e.g., fridge)	100%	98%	95.2%	95.8%	100%	100%	100%
		• Arrange medications according to FEFO	100%	99%	97.1%	100%	100%	100%	100%

Supplying (by the Pharmacy Department)									
4.	Check details in the indent form	• Ensure current stock balance is recorded	100%	46.2%	16.7%	25%	68%	66.7%	69%
		• Ensure the quantity indented is not more than the maximum allowable amount	100%	92.3%	91.7%	100%	84%	100%	100%
		• Ensure the indent form is signed	100%	57.7%	100%	96.4%	100%	100%	100%
		• Ensure usage of list A items is recorded	100%	96.2%	100%	100%	100%	100%	100%
5.	Record medications supplied	• Ensure the quantity supplied is not more than the maximum allowable amount	100%	88.5%	91.7%	100%	100%	100%	100%
6.	Counter-check and sign the indent form	• Ensure the indent form is signed by the staff who supplies the medications	100%	92.3%	100%	100%	92%	100%	100%
		• Counter-check the quantity supplied	100%	46.2%	58.3%	57.1%	72%	97%	96.6%
		• Ensure the counter checker signs the indent form	100%	46.2%	66.7%	57.1%	72%	97%	96.6%

staff in keeping the medications according to the correct temperature requirement. Despite implementing the remedial actions, the percentage of floor stock medications with excessive quantity increased from 4.8% to 10.5% at the end of Cycle 2.

In Cycle 3, the relevant SOPs were revised and reinforced. Before this study, excessive or expired medications were stocked up in the ETD without returning them to the in-patient pharmacy every month. In addition, there was no monitoring system in place to ensure the correct execution of SOPs related to medication return. This issue was highlighted to the ETD PIC, and medical assistants were reminded to return excessive or near-expiry medications to the in-patient pharmacy every month. On top of this strategy, the SOP on indenting and supplying floor stock medications was enforced in both departments to ensure proper documentation and counter-checking procedures. For example, pharmacy staff should reject the indent form during the medication indenting process if there are no stock balance records and signatures on the indent form. At the same time, pharmacy staff was also obliged to counter-check the medications supplied and sign at the designated columns during the supply and counter-checking processes. These remedial actions reduced the percentage of floor stock medications with excessive quantity to 5% at Cycle 3.

The re-evaluations conducted in Cycle 4 and Cycle 5 showed that the percentage of floor stock medications with excessive quantity was 5% and 1%, respectively. Both ETD and the Pharmacy Department showed improvement at the critical steps, although not achieving 100% due to inexperienced or new staff working on the weekend and public holiday shifts.

Results

During the verification study, 11 out of 98 (11.2%) floor stock medications in the ETD were found to have excessive quantities, and 1 (1%) of the floor stock medications were found to be expired. Among the 11 medications, the nebulising solution had the highest excess quantity. In Cycle 1 of this study, 5 out of 105 (4.8%) floor stock medications had excessive quantities, in which 4 of the medications were intravenous drips, and 3 (2.9%) floor stock medications were found to be expired. The percentage of floor stock medications with excessive quantity increased to 10.5% (10 out of 95) in Cycle 2, with 5 out of 10 floor stock medications being respiratory medications. No medication was found to be expired in Cycle 2. In Cycle 3, most processes were improved with proper remedial actions. There were 5 out of 100 (5%) floor stock medications with excessive quantities, and no medication expired. Further improvement was observed in Cycle 4 and 5. The standard set and ABNA for this study are depicted in Figure 3. The details are shown in Table 2.

An overall reduction in wastage cost due to excessive stock-keeping in the ETD was also observed in this study from MYR208.51 (≈USD50.36) in the verification study period to MYR39.88 (≈USD9.50) in Cycle 1, then MYR351.51 (≈USD83.73) in Cycle 2, MYR177.60 (≈USD4.25) in Cycle 3, MYR17.48 (≈USD4.22) in Cycle 4 and finally MYR5.00 (≈USD1.21) in Cycle 5.

Improvement was also observed in the ward inspection performance of the ETD after the implementation of the remedial actions from grade C during the verification study to grade B in Cycle 5 of this study.

Lessons and Limitations

In this study, the effectiveness of the remedial actions taken was affected by unforeseen circumstances. Despite implementing the remedial actions, excessive medication trends were erratic due to the COVID-19 pandemic. The management of floor stock medications in the ETD became challenging due to the shift in the types of diseases encountered, i.e., more efforts were made to concentrate on respiratory diseases from 2020 onwards. The management of floor stock medications became tougher with staff mobilisation to help in the COVID-19 treatment centres, long working hours and

physical and mental burnout among the ETD staff. This phenomenon was in line with the studies that reported that healthcare workers suffered stress during the pandemic (16-18), which affected workplace performance. The consequences of the COVID-19 pandemic could be seen in Cycle 1 (the end of the second COVID-19 wave) and Cycle 2 (the start of the third COVID-19 wave), where weaker performances in floor stock medication management were portrayed.

The increment of ABNA during Cycle 2 could be attributed to several factors. Firstly, changes in the disease(s) or condition(s) being managed in the ETD resulted in different types of medications becoming excessive in the department. This highlighted that the environment of the ETD is dynamic and the challenges faced by the department are constantly changing. For example, nebulising solutions were commonly detected to be in excessive quantity during ward inspection in Cycles 1 and 2 because more presumed COVID-19 patients were managed in the ETD during that period and pressurised metered-dose inhalers were used instead of nebulising solutions to reduce the spreading of the virus through nebulisation. This practice was consistent with the treatment guideline suggested by the Malaysian Thoracic Society (19). Hence, continuous monitoring of floor stock medications by the ETD and Pharmacy Department is essential to ensure the quantities of the medications do not become excessive while remaining appropriate for current conditions.

Secondly, staff were not familiar with the SOPs. Therefore, inexperienced staff should be continuously educated on proper workflow and SOPs through continuing medical education. Also, alternative methods, such as webinars or online briefings, had to be sought after in abiding to the SOP. Thirdly, shifts in staffing during the COVID-19 pandemic were unpredictable, limiting the execution of remedial actions. The consequences were evident in Cycle 2 when staff was mobilised to the COVID-19 treatment centres. Finally, the data were only obtained from the ward inspection period. In this study, the number of

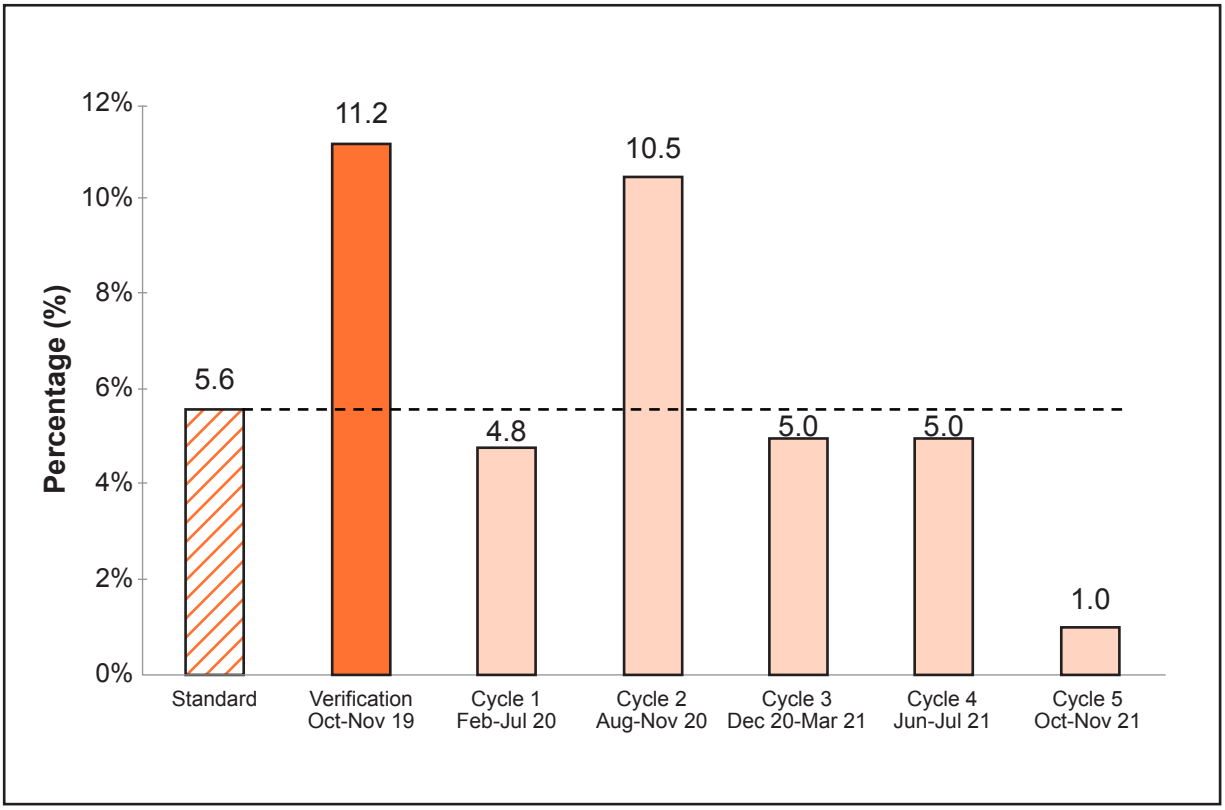

Figure 3: Achievement of the indicator by cycles

ward inspections reduced from three to two times a year in 2020 due to COVID-19, which could have affected the observed results.

Despite the limitations, there were lessons learnt through this study. It was noteworthy that improvement in the management of floor stock medications mainly stemmed from the PIC, i.e., specialist, chief medical assistant, chief nurse and pharmacy staff. Although the PIC might not be directly involved in the whole process of care, persistent effort from the PIC in monitoring and strengthening SOPs was crucial to reducing excessive floor stock medications in the ETD. This finding has underscored the importance of a multidisciplinary approach at the management level, e.g., through group discussion or dialogues, to ensure the target set can be attained efficiently and effectively. Besides, it was observed that frequent revision was essential to maintain the necessary types and numbers of medications in the ETD, especially during this pandemic. Even though it was impractical to change the list constantly, the practice of returning unused or excessive medications to the in-patient pharmacy could prevent medications from expiring unknowingly. Notably, adherence to SOPs should be highlighted, especially in counter-checking and recording the balance of medications before indenting and supplying processes. This is because the strategies planned would be in vain without proper adherence to SOPs. We believed that the strategies implemented in this study were essential and could be replicated in other units or hospitals involving medication stock management.

Conclusion and the Next Steps

This study successfully reduced the percentage of floor stock medications with excessive quantity in the ETD to the targeted percentage of 5.6% from 11.2% in the pre-intervention phase and subsequently to 1% post-implementation of strategies. Besides, there was also an overall reduction in the wastage cost, as well as improvements in ward performance in terms of medication stock management. Furthermore, the same strategies have been replicated in all other units/wards in Port Dickson Hospital, and the authors expect more reduction of excessive medications and wastage costs throughout the year.

The QA team will monitor the work processes continuously to ensure targets are achieved in the hospital. Implementing electronic recording through the Pharmacy Information System (PhIS) can help ensure proper medication tracking and reduce the workload from manual recording and counter-checking. Discussions regarding the implementation of electronic recording through PhIS will be conducted through meetings and seminars, and efforts from all stakeholders are required to make it successful in the future.

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Conflict of Interest

The authors declare that there was no conflict of interest.

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Appendix 1

Example of floor stock medication indent form kept in the Emergency and Trauma Department, Port Dickson Hospital

TARIKH:.....

Farmasi RN:.....

BIL		MIN	MAX	BAKI	PESAN	BEKAL
	UBAT BUI					
1	Charcoal Activated Granules 50g	2	4			
2	Acetylsalicylic Acid 300 mg Soluble Tablet	10	20			
3	**Clopidogrel 75 mg Tablet*** **	15	30			
4	Glyceryl Trinitrate 0.5 mg Tablet (30 tab)	1	2			
5	Captopril 25mg Tablet	10	20			
	CREAM, LOTION, SOLUTION					
1	Alcohol 70% Solution (240mL)	2	4			
2	Cetrimide 1% Lotion (120mL)	4	8			
3	Chlorhexidine Gluconate 5% Solution	500ML	1 L			
4	Formalin 10% Buffered Solution	3.8L	3.8L			
5	Hydrogen Peroxide 20 volume Solution (6%)	500ML	1 L			
6	Silver Sulfadiazine 1% Cream	250 G	500 G			
7	Ether Solvent	250 mL	500 mL			
8	Chlorhexidine 1 in 200 (0.5%) in Alcohol 70% (240mL)	2	4			
9	Chlorhexidine Gluconate 2% in Alcohol 70% Solution	1 (EB)	2 (EB)			
10	Povidone Iodine 10% Solution (60mL)	5	10			
11	Acriflavine 0.1% Lotion	5	10			
	EYE/EAR DROP/OINTMENT					
1	Chloramphenicol 1% Eye Ointment	5	10			
2	Chloramphenicol 0.5% Eye Drops	5	10			
3	Chloramphenicol 5% w/v Ear Drops	3	5			
	IV DRIP					
1	Dextrose 5% 500ml IV soln (D5%)	10	20			
2	Dextrose 10% 500mL IV soln (D10%)	10	20			
3	Modified Fluid Gelatin 4% 500mL IV Solution (Gelofusine)	2	5			
4	Sodium Chloride 0.45% 500mL IV soln (HS)	5	10			
5	Sodium Chloride 0.45% with Dextrose 5% 500mL IV soln (HSD5)	10	20			
6	Sodium Chloride 0.9% 100mL IV soln (NS)	10	20			
7	Sodium Chloride 0.9% 500mL IV soln (NS)	40	80			
8	Sodium Lactate Compound 500mL IV soln (HM)	20	40			
9	Sodium Chloride 0.9% 500mL Irrigation Soln	5	10			
10	Sodium Chloride 0.9% 3L Irrigation Soln	1	4			
11	Sodium Cl, Sodium Ace, Malic Acid, Calcium Cl, Potassium Cl, Magnesium Cl (Sterofundin) 500ml IV Sol	5	10			
12	Sterile Water for Irrigation 500mL	5	10			
	UBAT LAIN					
1	Ethyl Chloride Spray	3	5			
2	Fuller's Earth Powder	1	3			
3	Ipratropium Bromide 0.025% Nebulising Soln (250 mcg/ml) UDV	20	40			
4	Ipratropium Br 0.5mg, Salbutamol 2.5mg Neb (UDV)	30	60			
5	Glucose Powder	1	3			
6	Lignocaine (Lidocaine) 10 % w/w Spray	1	3			
7	Lignocaine 2% Jelly	3	5			
8	Paracetamol 125 mg Suppository	10	20			
9	Paracetamol 250 mg Suppository	10	20			
10	Salbutamol 0.5 % Nebulising Solution	5	10			
11	Terbutaline Sulphate 10 mg/ml Nebulising Solution	1	3			
12	Budesonide 1 mg/2 ml Nebulising Solution (Respules)	3	5			
13	Salbutamol 100 mcg/dose Inhaler (200 doses)	1	5			
14	Sodium Dichloroisocyanurate 2.5g Tablet	1	1			
	UBAT NEUROMUSCULAR PARALYTIC					
1	Atracurium Besylate 25mg/2.5ml Injection	1	3			
2	Neostigmine Methylsulphate 2.5mg/ml Injection	1	3			
3	Propofol 1% Injection (200mg/20ml Vial)	1	3			
4	Rocuronium Bromide 10mg/ml Inj	1	3			
5	Suxamethonium Chloride 50 mg/ml Inj	5	10			

BIL		MIN	MAX	BAKI	PESAN	BEKAL
	UBAT SUNTIK					
1	Insulin regular (Actrapid) 100 IU/mL Vial	1	3			
2	Acetylcysteine 5000mg/25ml Injection	3	5			
3	Aminophylline 25mg/ml	3	5			
4	Antivenene Cobra Injection	1	5			
5	**Hematotoxic Polyvalent Snake Antivenom**	1(EB)	1(EB)			
6	**Neurotoxic Polyvalent Snake Antivenom**	1(EB)	1(EB)			
7	Antivenene Serum Sea snake 1000 units Injection	1(EB)	1 (EB)			
8	Calcium Gluconate 10% Injection	3	5			
9	Chlorpheniramine 10mg/ml Injection	10	20			
10	Dexamethasone Sodium Phosphate 4mg/ml	10	20			
11	Dextrose 50% 10mL Inj	10	20			
12	Diclofenac Sodium 75mg/3 ml Injection	25	50			
13	Enoxaparin 40mg Injection	5	10			
14	Fondaparinux 2.5 mg/0.5ml Injection	5	10			
15	Frusemide 10mg/ml	10	20			
16	Haloperidol 5 mg/ml Injection	3	5			
17	Heparin Sodium 5000 IU/ml Injection (5ml)	1	3			
18	Heparin Sodium 50 IU/5ml in Sodium Chloride Injection (heparin in NaCl)	10	20			
19	Hydrocortisone Sodium Succinate 100mg Inj	20	40			
20	Hyoscine N-Butylbromide 20mg/ml Injection	10	20			
21	Labetalol HCl 25 mg/5 ml Injection	5	10			
22	Levetiracetam 100mg/ml Injection	2	5			
23	LIGNOcaine HCl (Lidocaine) 2% Injection (10ml)	10	20			
24	Metoclopramide HCl 10mg/2ml Injection	25	50			
25	Oxytocin 10 units/ml Injection	1	3			
26	Oxytocin 5U + Ergometrine 0.5mg/ml Inj	1	3			
27	Sodium Valproate 400 mg Injection	1	3			
28	Pantoprazole 40mg Injection	10	20			
29	Vitamin B and C (P-Trovite) 10mL Inj	1 Pair	3 Pair			
30	Potassium Chloride 1g/10ml Injection	5	10			
31	Prochlorperazine Mesylate 12.5 mg/ml Inj	5	10			
32	Promethazine HCl 25 mg/ml Injection	5	10			
33	Ranitidine 50mg/2ml Injection	20	40			
34	Sodium Bicarbonate 8.4% (1 mmol/ml) Injection	20	40			
35	Paracetamol 10mg/ml in 100ml solution	3	5			
36	Streptokinase 1,500,000 IU Injection	1 (EB)	3 (EB)			
37	Terbutaline Sulphate 0.5mg/ml Injection	5	10			
38	Tenecteplase 10,000 unit (50mg) Injection	1(EB)	2 (EB)			
39	Tetanus Toxoid Injection (10 doses)	5	10			
40	Thiamine HCl 100mg/ml Injection	2	5			
41	Tramadol HCl 50 mg/ml Injection	25	50			
42	Tranexamic acid 100mg/ml Injection	5	10			
43	Verapamil HCl 5mg/2ml Injection	3	5			
44	Vitamin K1 (Phytomenadione) 10 mg / ml Injection	3	5			
45	Sterile Water for Injection 10mL	25	50			
	UBAT SUNITK ANTIBIOTIK					
1	Amoxicillin 1g + Clavulanate 200mg Injection	10	20			
2	Ampicillin 1g + Sulbactam 500mg Injection	3	5			
3	Ceftriaxone 1g Injection	3	5			
4	Cefuroxime 750mg Injection	3	5			
5	Metronidazole 500mg/100ml Injection	3	5			

***** Kegunaan ubat kategori A perlu dicatat dalam buku rekod.**

EB ***Exchange basis***

IMPROVING EYE DROP ADMINISTRATION TECHNIQUE AMONG GLAUCOMA PATIENTS IN THE OUTPATIENT PHARMACY DEPARTMENT AT TUANKU AMPUAN NAJIHAH HOSPITAL

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Abstract

Intraocular pressure-lowering eye drop medications are the initial treatment of choice for glaucoma. A correct administration technique is necessary to optimise treatment efficacy, reduce adverse effects and prevent medication wastage. However, studies have shown that glaucoma patients experience various administration problems, such as drops falling onto the cheeks, releasing too many drops and bottle tip touching the eye. Seven steps in the eye drop administration process were identified as critical and clinically relevant. A verification study conducted between March to May 2020 in the Outpatient Pharmacy Department (OPD), Tuanku Ampuan Najihah Hospital (HTAN) revealed that only 4.2% of the glaucoma patients performed all seven critical steps (n=118). Therefore, this study aimed to increase the percentage of glaucoma patients who can correctly perform all seven critical steps in the eye drop administration process during follow-up counselling from 4.2% to 60%. The contributing factors towards poor eye drop administration technique in glaucoma patients were lack of optimal medication counselling by doctors and pharmacists, as well as lack of skill of patients. Hence, a standard workflow was developed to encourage doctor-pharmacist collaboration and improve pharmacists' eye drop medication counselling process. Educational aids and an assessment checklist were developed as counselling tools. A second medication counselling session was scheduled within one month to re-assess and re-enforce the patient's technique. Following the first intervention cycle, the percentage of patients who were able to perform all seven critical steps during the second session increased to 36.4%. Subsequent improvements in the process of care and counselling tools during the second intervention cycle led to a further increase to 72%. In conclusion, this study achieved its aim of improving eye drop administration techniques among glaucoma patients through shared resources and collaboration between the Ophthalmology Department and OPD.

KEYWORDS: Eye drop, Administration technique, Glaucoma, Quality study, Medication counselling

Problem

Glaucoma is a chronic disease with progressive optic neuropathy that can lead to serious vision loss and blindness (1). Surgery, laser treatment, medications or a combination of these treatment modalities are used to lower intraocular pressure (IOP) and prevent disease progression (1–3). Patients prescribed with IOP-lowering eye drop medications must perform proper instillation to optimise treatment outcomes and prevent adverse effects (4). Upon initiation of eye drop medication, patient education by healthcare providers is necessary to ensure proper instillation technique and treatment adherence (1).

Tuanku Ampuan Najihah Hospital (HTAN) is a district specialist hospital in the town of Kuala Pilah in Negeri Sembilan. It is the lead hospital in a cluster system that includes Tampin Hospital and Jempol Hospital. It has 12 specialist departments, including an Ophthalmology Department. The Ophthalmology Department had an average of 1,120 patient visits per month in 2020. On the other hand, the hospital's Pharmacy Department is divided into five divisions: Ward Pharmacy, Inpatient Pharmacy, Logistics Pharmacy, Pharmacy Resource and Information Centre and Ambulatory Pharmacy. The Outpatient Pharmacy Department (OPD) is a part of the Ambulatory Pharmacy. It employs 17 pharmacists and five pharmacy assistants who ensure the safety, quality and efficacy of medication dispensing from specialist clinics through meticulous prescription screening, recommendations of evidence-based interventions and medication counselling.

Due to the high patient load and various physical examinations during each appointment, doctors in the Ophthalmology Department at HTAN often have limited time for proper patient education. Meanwhile, in the OPD, eye drop counselling is often done briefly over the counter during the medication dispensing without proper assessment of patient understanding and counselling outcomes. Improper eye drop administration puts patients at risk of suboptimal therapeutic outcomes and medication side effects. The Pharmacy Practice and Development Division of the Ministry of Health (MOH), Malaysia, had received reports of patients using scissors to pierce the bottle tips of Timolol IOTIM eye drops instead of using the spike at the inner top of the bottle's cover as recommended by the manufacturer (5). Such action could cause contamination, inaccurate dosing and wastage.

This study aimed to increase the percentage of glaucoma patients who can correctly perform all seven critical steps in the eye drop administration process from 4.2% to 60% during the second counselling session within a short period.

Background

Studies showed that glaucoma patients face various challenges in eye drop administration. A one-year cross-sectional study conducted at Raja Permaisuri Bainun Hospital using a Brief Medication Questionnaire among glaucoma patients (n=100) reported that 45% of patients had eye drops falling on their cheeks, while 42% of patients had too many drops released from the eye drop bottle (6). A study conducted in German community pharmacies reported that only 6% of 138 patients observed were administering the eye drops correctly (7). An improper technique can lead to medication waste, poorer efficacy as indicated by worsening IOP, increased cost, decreased patient satisfaction and traumatic ocular surface injuries from touching the bottle tip onto the eye (4,8).

An incorrect eye drop administration is attributed to knowledge-based or skill-based factors. Studies showed that most patients did not receive formal instruction on eye drop administration, leading to poor knowledge and incorrect technique (2,6). In addition, the ability to correctly instil eye drops is affected by physical capabilities, such as manual dexterity to open and squeeze the eye drop bottle and visual acuity to instil the drops into the eye (7). Furthermore, a study conducted by Choy

et al. (2019) in Hong Kong demonstrated that patients with a higher Fatigue, Resistance, Ambulation, Illness and Loss of Weight (FRAIL) score, which indicates functional impairment and frailty due to old age and other co-morbidities, are associated with poor eye drop administration (10).

Most studies utilised patient education as an intervention to improve patients' eye drop administration techniques (4,7,10). Lampert et al. (2019) identified seven critical steps in eye drop administration. They demonstrated that patient education, which includes observation to identify errors, counselling and reinforced training, significantly improved eye drops administration skills from 6% (n=138) at baseline to 35% (n=69) at the one-month follow-up and 64% (n=44) at the six-month follow-up (7). The observation method used in this study was critical because studies had proven that patients often overrate their ability to administer eye drops (2,4,7). For example, a multi-centre evaluation of eye drops administration technique in patients with glaucoma or ocular hypertension in the United States and Canada showed that while only 11.4% of patients self-reported difficulty in administering eye drops, an evaluation through observation revealed up to 42.1% of them facing difficulty in administering eye drops (11). A study in ophthalmology clinics at the University of Minnesota reported that a short educational briefing using a video and illustrated hand-out significantly improved the patients' eye drop administration technique (4). On the other hand, Choy et al. (2019) demonstrated that patient education among elderly glaucoma patients in Hong Kong (n=28, mean age=71.54 years) improved the percentage of patients with satisfactory eye drop administration techniques from 35% to 65% (10).

Measurement

This study aimed to increase the percentage of patients who could perform all seven critical steps in the eye drop administration process, as observed by the pharmacist during the second medication counselling session to 60%. The percentage was calculated as the number of patients who performed all seven critical steps correctly during the second session over the total number of patients who came for the second session. This standard was set based on the study by Lampert et al. (7) and the consensus with the doctors in the Ophthalmology Department, HTAN.

The seven critical steps were essential to optimise treatment efficacy while avoiding local and systemic adverse effects. They were selected based on the Malaysian Clinical Guidelines on Management of Glaucoma 2017 (1), the study by Lampert et al. (7) and a discussion with the Ophthalmology Department of HTAN. The seven steps were hand washing; opening and puncturing the tip of the bottle; instillation into the conjunctival sac; instillation of one drop; closing the eyes with concomitant nasolacrimal occlusion for two minutes; avoiding touching the dropper tip throughout the whole process; and waiting for five minutes in between eye drops.

Initial Assessment of the Problem

A verification study using a validated questionnaire on 118 purposively selected glaucoma outpatients was conducted between March and May 2020. All glaucoma patients above 18 years old, with incorrect eye drop administration techniques and referred by doctors to pharmacists for medication counselling were included. The doctors identified these patients based on clinical evaluations, such as increasing IOP and patient feedback. In cases where a caregiver administers eye drops for the patient, the caregiver was eligible for study participation. Patients with cognitive impairment and patients who stated that they were unable to be present for follow-up counselling were excluded from the study.

The study results were based on assessment during the second counselling session rather than immediately after the first session because Lampert et al. (7) had shown that errors resolved in the first session might recur in the second session and repeated

corrections were needed. Data were collected daily in the OPD through the Medication Counselling Referral Form (refer to Appendix 1) and Counselling Observer Assessment Checklist (refer to Appendix 2). The checklist served as an assessment tool to evaluate the eye drop technique of the patient. It was a concise and simplified version of the checklist published by the Pharmaceutical Services Programme, MOH, Malaysia (12).

The process of care in the Ophthalmology Department (refer to Appendix 3) and eye drop medication counselling in the OPD (refer to Figure 1) were identified to determine the steps in ensuring correct eye drop medication among glaucoma patients. In the Ophthalmology Department, doctors conduct physical examinations and identify patients who do not instil eye drops correctly. The doctors will then counsel the patients on the correct eye drop administration technique and complete relevant documentation. In the OPD, pharmacists identify patients who need eye drop counselling during screening or dispensing. Those needing counselling are usually patients who are newly started on eye drops or have expressed difficulties in administering eye drops. Patients are mostly counselled over the counter. Based on the assessment by the pharmacists, patients who require re-enforcement will be given an appointment date for follow-up counselling.

The critical steps in the process of care include the identification of patients who require eye drop counselling, counselling and assessment of the patient's technique,

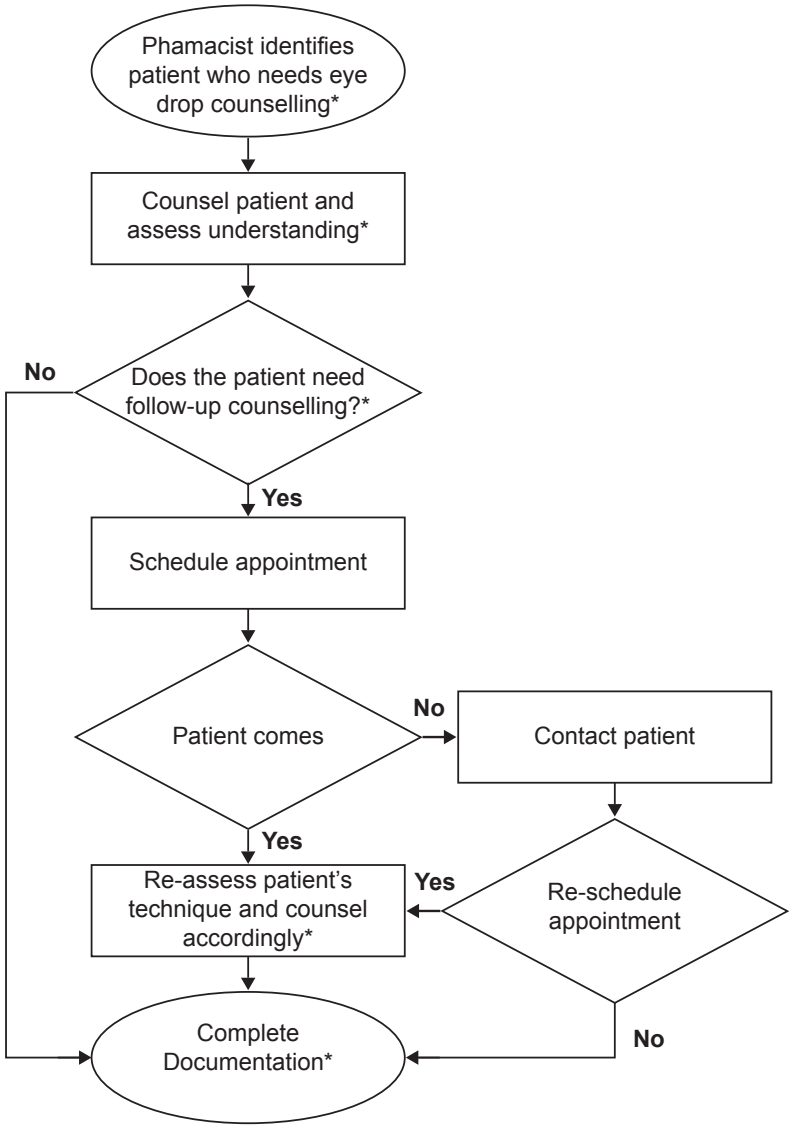

Figure 1: Flowchart of the process of care for eye drop medication counselling in the Outpatient Pharmacy Department (*indicates critical steps)

ensuring follow-up counselling is conducted and documentation. The evaluation of the process of care revealed a lack of process continuity between the Ophthalmology Department and OPD, as well as no standardised assessment of the patient's eye drop administration technique.

Besides that, a cause-effect analysis was conducted to determine the possible factors contributing to improper eye drop administration among glaucoma patients (refer to Figure 2). Three main factors were identified, which were the patient's lack of knowledge, poor dexterity and poor vision.

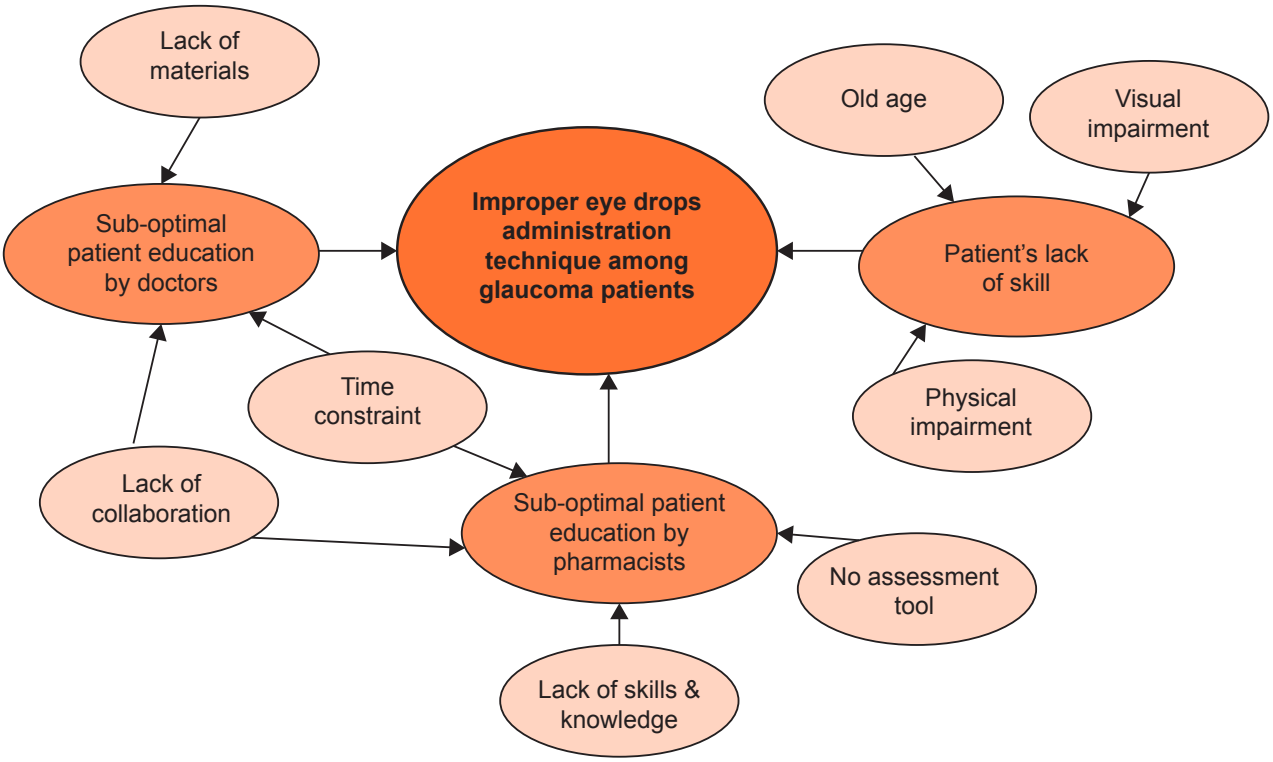

Figure 2: Cause-effect analysis of improper eye drop administration technique among glaucoma patients

Validated questionnaires were distributed to glaucoma patients in the outpatients (n=118), doctors in the Ophthalmology Department (n=13) and pharmacists in the Pharmacy Department (n=58) to verify the contributing factors. Results revealed that only 4.2% of the glaucoma patients surveyed performed all seven critical steps in eye drop administration. The least performed knowledge-based step was closing the eye with nasolacrimal occlusion (42%). The main skill-based challenge faced by patients was eye drops not falling into the eye (27%). Concerning patient education, only 69% of doctors and 21% of pharmacists reported that they always counsel glaucoma patients who are newly started on eye drop medications, while only 55% of doctors and 2% of pharmacists re-assess the administration technique of patients who are already using eye drops. The main barrier to eye drops counselling for doctors was time constraint (100%), whereas the main barriers for pharmacists were lack of doctor referrals (76%) and time constraint (72%). Surprisingly, 62% of doctors in the Ophthalmology Department were unaware of any avenues available to refer patients to pharmacists for medication counselling, even though medication counselling is an established pharmacy service.

Strategy

Two intervention cycles were conducted in this study to improve doctor-pharmacist collaboration and to provide effective and standardised eye drop administration counselling to glaucoma patients. Cycle 1 was conducted between June 2020 and January 2021 with four main strategies implemented, while Cycle 2 was conducted between February 2021 and June 2021 to strengthen the effectiveness of the strategies from Cycle 1.

In Cycle 1, a new process of care was developed for referral by doctors in the Ophthalmology Department and eye drop administration counselling by pharmacists in the OPD (refer to Figure 3). Medication Counselling Referral Forms were distributed to the Ophthalmology Department and the doctors were informed of the referral process and criteria. Following this, the OPD received 30 referrals in Cycle 1. The number of referrals was lower than expected because of the reduction in clinic appointments due to the Movement Control Order during the height of the COVID-19 pandemic. After Cycle 1, feedback was received from the doctors stating that a simplified form would ease the referral process. Subsequently, the referral form was simplified in Cycle 2 by removing unnecessary options and information to be filled.

Moreover, in Cycle 2, the doctor counselling referral and assessment checklist were combined into one form. The checklist was modified to include columns for counselling reference numbers and the signature and stamp of the pharmacist. With this, the pharmacist needed not to fill up a separate counselling form for documentation, hence, decreasing documentation time.

The next strategy aimed to improve and standardise the quality and effectiveness of the eye drop technique counselling by pharmacists in the OPD. A Counselling Observer Assessment Checklist was developed as a tool for pharmacists to evaluate patients' techniques and counselling outcomes (refer to Appendix 2). Based on the new workflow, evaluation was done by observing the patient's technique using normal saline eye drops. This enabled the pharmacist to identify and address the patient's administration errors accordingly.

Pharmacists were required to schedule a follow-up counselling session for all counselled patients. The second session aimed to evaluate whether the patient still practises all seven critical steps correctly and to provide any necessary re-enforcement. However, due to the low turn-up rate for scheduled appointments, reminders were sent via SMS or phone calls two to three days prior to the patient's appointment for Cycle 2. Phone calls were found to be more effective than SMS-based reminders.

Furthermore, educational tools such as videos and charts were produced to standardise counselling points and improve patients' understanding. However, the video and chart were used in only 55% of the counselling sessions conducted during Cycle 1 (n=30). Therefore, the video was modified in Cycle 2 based on the feedback from pharmacists and doctors, using minimal words, larger fonts and clearer graphics. The length of the video was also shortened from 2 minutes 40 seconds to approximately 1 minute. Besides English, the video was also produced in Bahasa Malaysia, Mandarin and Tamil. In addition, education charts were removed and replaced with pamphlets that can be brought home.

Results

After two cycles of remedial actions, the percentage of patients performing all seven critical steps of eye drop administration during the second counselling session increased from 4.2% to 36.4% and subsequently to 72% (refer to Figure 4). The Achievable Benefit Not Achieved (ABNA) decreased from 55.8% to 23.6% and finally to -12%.

Further analysis showed an increase in percentage for each critical step in Cycle 2 compared to Cycle 1. Four steps did not achieve 100% performance in Cycle 2, namely handwashing (83.3%), closing the eye and

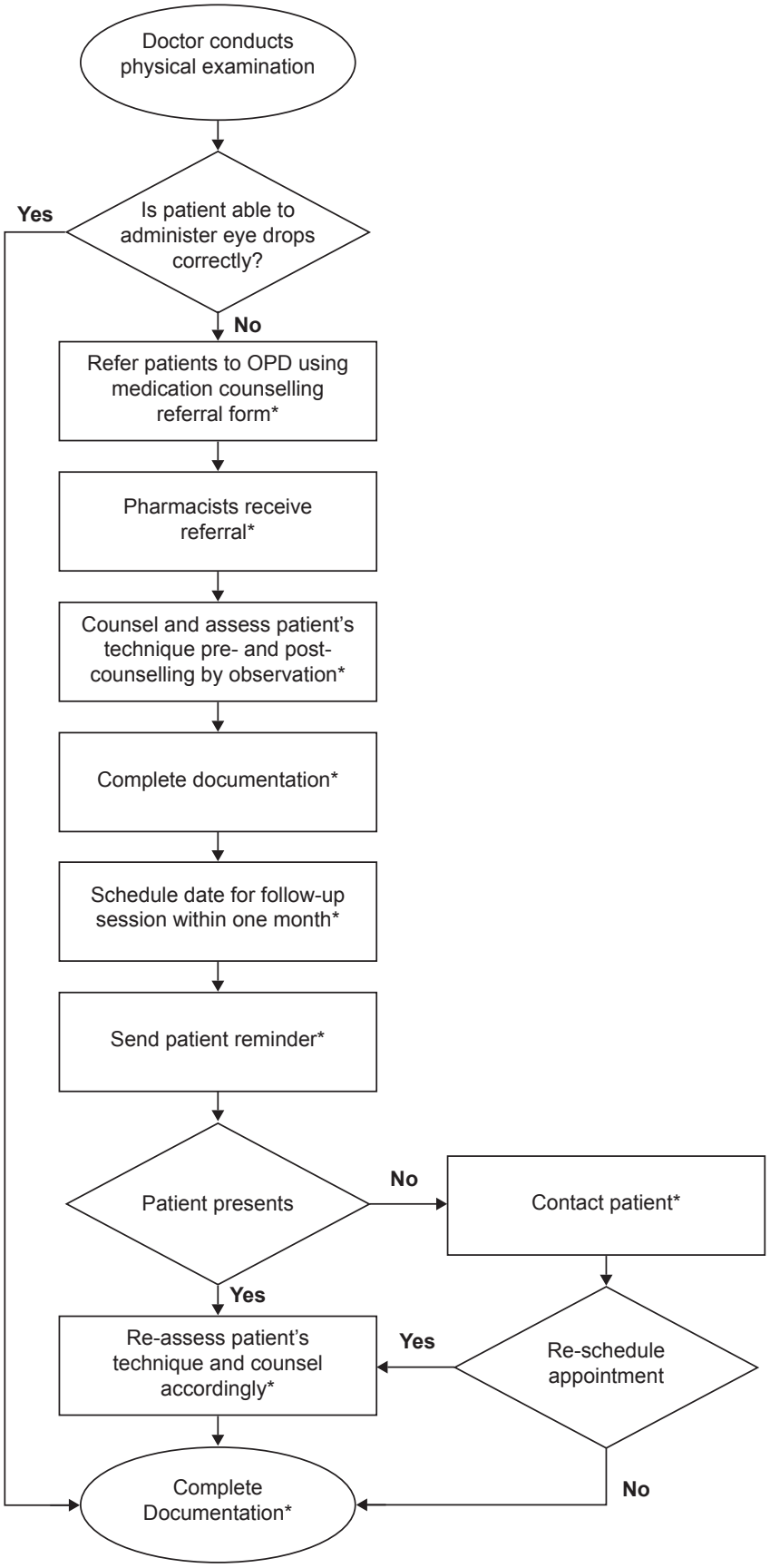

Figure 3: New process of care for eye drop administration technique referral and counselling in the Ophthalmology Department and Outpatient Pharmacy Department (* indicates critical steps)

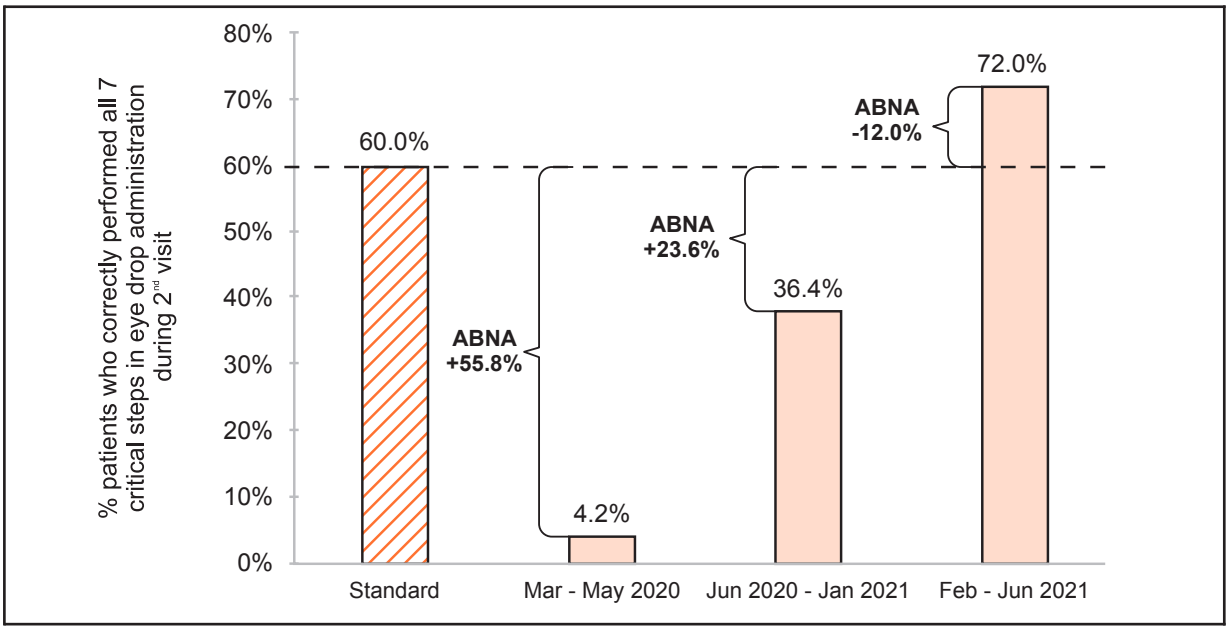

Figure 4: Trend in the percentage of patients who correctly performed all seven critical steps in eye drop administration during the second medication counselling session (ABNA analysis)

nasolacrimal occlusion for 2 minutes (77.7%), avoiding touching the tip of the eye drop bottle throughout the whole process (94.4%) and waiting for 5 minutes in between eye drops (88.8%).

Collaboration between doctors and pharmacists addressed the time barrier of patient counselling and education. Pharmacists increasingly utilised the modified video and pamphlet to provide standardised counselling and improve patient understanding. Moreover, improvement in pharmacists' counselling skills over the study's duration may have contributed to better outcomes in Cycle 2.

This study evaluated the IOP of patients before and after counselling to determine the clinical impact. A total of 42.9% of patients who correctly performed all seven critical steps one month after counselling in Cycle 1 and 2 showed a reduction in IOP, whereas 19% showed no changes and another 19% showed an increase in IOP. In this study, the files and IOP results of 14.3% of the patients were untraceable. The reason was that these patients could have been referred to other facilities. Other than the eye drops administration technique, IOP could be affected by other factors, such as treatment adherence, disease progression and treatment efficacy (3,8).

All criteria in the Model of Good Care (MOGC) showed improvement after intervention (refer to Table 1). For example, the use of counselling aids increased from 55% in Cycle 1 to 62% in Cycle 2. Although utilisation of the counselling aids was highly encouraged, there were situations where the counselling aids were not viable, such as in patients with visual or hearing impairment. In these cases, pharmacists would need to counsel by demonstration and guidance. Besides, the scheduling of follow-up counselling increased from 82.1% to 100%. It is to be noted that completing the documentation for OPD Counselling Form is not applicable in Cycle 2 because the form was abolished and incorporated into the Assessment Checklist Form.

Table 1: Model of Good Care to improve eye drop administration technique among glaucoma patients in Outpatient Pharmacy Department

No	Procedure	Criteria	Standard	Verification (n=58)	Cycle 1 (n=31)	Cycle 2 (n=21)
1.	Refer patient to OPD using medication counselling referral form	Refer patients with incorrect eye drop administration to a pharmacist using the medication counselling referral form	100%	0%	100%	100%
2.	Pharmacists receive referral	Receive all patients referred for counselling by prescribers	100%	0%	100%	100%
3.	Counsel patient and assess patient's technique pre- and post-counselling	• Assess the patient's eye drop administration by observation	100%	0%	100%	100%
		• Use eye drop administration videos or counselling charts (Cycle 1) or pamphlets (Cycle 2) as counselling aid	100%	0%	55%	62%
		• Counsel and re-assess the patient's eye drop administration by observation	100%	0%	100%	100%
		• Assess the patient's understanding and compliance with medications	100%	100%	100%	100%
4.	Schedule a date for follow-up counselling within one month	Schedule a date for follow-up counselling within one month	100%	0%	82%	100%

5.	Complete documentation	• Outpatient Pharmacy Department Counselling Form	100%	100%	100%	N/A (Note: This form was combined with the assessment checklist form)
		• Follow-up counselling registration form	100%	0%	100%	100%
		• Assessment checklist form	100%	0%	100%	100%
6.	Send patient reminder	Remind the patient by calling 2-3 days prior to the appointment date	100%	0%	N/A	100%
7.	Re-assess the patient's technique and counsel accordingly	• Re-assess the patient's eye drop administration by observation	100%	0%	100%	100%
		• Assess the patient's understanding and compliance with medications	100%	100%	100%	100%
8.	Complete documentation	• Outpatient Pharmacy Department Counselling Form	100%	100%	100%	N/A (Note: This form was combined with the assessment checklist form)
		• Follow-up counselling registration form	100%	0%	100%	100%
		• Assessment checklist form	100%	0%	100%	100%

Lessons and Limitations

This study highlighted that poor eye drop administration techniques were prevalent among glaucoma patients at HTAN and improvement measures were necessary. The results showed that doctor-pharmacists collaboration could improve patient care by leveraging and sharing resources. Ophthalmology doctors can identify patients who need medication counselling based on the patient's clinical results and initial assessment of the administration technique. On the other hand, pharmacists are trained to provide medication counselling and access the resources needed. Also, support from the Head of Departments and cooperation from colleagues are necessary to achieve the aim of this study. Finally, periodical discussions are required in order to streamline and improve the process of care.

The main challenges encountered were the small sample size of patients referred by doctors and the low patient turn-up rate for follow-up counselling. However, the number of referrals received increased in Cycle 2 after the positive results from Cycle 1 were presented to the doctors in the Ophthalmology Department. Additionally, the number of patients visiting the Ophthalmology Department increased in Cycle 2 when Negeri Sembilan entered the Recovery Movement Control Order and Conditional Movement Control Order phases during the COVID-19 pandemic.

Conclusion and the Next Steps

In conclusion, this study enforces the need for patient education and counselling in improving glaucoma patients' eye drop administration techniques. Similar to other chronic medical conditions, such as diabetes and chronic obstructive pulmonary disease, glaucoma patients require periodic evaluation and re-enforcement of proper technique and adherence. Following this study, pharmacists in the OPD at HTAN have become more aware of the need to provide effective eye drop administration counselling to glaucoma patients. The importance of evaluation by patient observation is also demonstrated as it enables the pharmacist to assess the patient's technique and provide targeted counselling should the need arise. Discussion with the Ophthalmology Department has also led to standardised counselling points to minimise patient confusion.

Nevertheless, continuous cooperation between doctors and pharmacists is necessary to sustain the process of care and interventions. Periodical continuing medical education and briefing should also be conducted, especially for the new ophthalmology doctors and pharmacists.

The collaboration initiated in this study could lead to further projects in improving patient care. This study can be applied to hospitals with Ophthalmology Departments and OPD to improve eye drop administration techniques among glaucoma patients. The Counselling Observer Assessment Checklist Form can be used and adapted to suit the facility's setting. In addition, the facility can also use the Medication Counselling Referral Form or its own facility referral form. The workflow can be easily adopted since medication counselling is an established pharmacy service. This study could potentially be expanded to include medication adherence and storage aspects of eye drop medications.

Acknowledgement

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Conflict of Interest

The authors declare that there was no conflict of interest.

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Appendix 1

Medication Counselling Referral Form

LAMPIRAN 1

BORANG PERMOHONAN KAUNSELING
FARMASI KLINIK PAKAR
JABATAN FARMASI HOSPITAL TUANKU AMPUAN NAJIHAH

Nota: Diisi oleh Pegawai Perubatan dan lampirkan bersama preskripsi ubat

1) Data Pesakit

Nama Pesakit _____

IC _____ Umur (tahun) _____

Jantina Lelaki ☐ Perempuan ☐

Bangsa Melayu ☐ Cina ☐ India ☐ Lain-lain ☐

Tujuan kaunseling
1. Kaunseling ubat ☐
2. Penilaian kepatuhan ubat ☐

Diagnosis _____

Alergi ubat Tidak ☐ Ya ☐ Nyatakan _____

Kad alergi Tidak ☐ Ya ☐ No kad _____

Senarai ubat terkini	Sejarah Pengubatan (Jika ada)
Nama ubat, Dos & Frekuensi	***Nama ubat, Dos & Frekuensi***

2) Jenis Kaunseling yang Dirujuk

Cara mengguna ubat titis mata ☐
Lain-lain: _____ ☐

Catatan (Diisi oleh Pegawai Perubatan jika ada):

IOP:

RVA: LVA:

_____
Tandatangan
Nama & Cop Pegawai Perubatan

Tarikh:

1 A collaborative quality assurance study between Outpatient and Ophthalmology Department, HTAN (Updated: 6.7.21)

Appendix 2

Counselling Observer Assessment Checklist

Counselling Ref No.
1st visit:
2nd visit:

FOR PHARMACY USE

Pre- and post-counselling observer assessment checklist

(Tick √ for each correct step)

1. Phone No : .....
2. Dr's TCA date : .....
3. Referred to pharmacist for eye drops counselling before: Y / N
4. Request for SPUB: Y / N

No	**Assessment criteria** (for patient to demonstrate using normal saline eye drops)	**1st session**		**2nd session**
		Pre-counselling	Post-counselling	Pre-counselling
*1	Hand-washing (mentioning this step is sufficient)			
2	Shake eye drop bottle			
*3	Able to open (for all eye drops) and/or PUNCTURE eye drop bottle (for Timolol IOTIM / Dorzolamide OCUDOR) correctly			
4	Tilt head backwards			
5	Look up when administering eyedrops			
6	Pull down lower eyelid to form a pocket			
*7	Instillation into conjunctival sac			
*8	Instillation of ONE (1) drop			
*9	Close eye with concomitant nasolacrimal occlusion for approximately TWO (2) minutes			
*10	Avoid touching dropper tip throughout process			
11	Replace bottle cap			
*12	Wait for FIVE (5) minutes between eye drops			
13	Wipe away excess tears/eye drops with tissue			
	Total score (1 point for each correct step)	/13	/13	/13
	Total score for critical steps (marked as *)	/7	/7	/7

Notes : Kindly write any specific problem faced and advice given to patient.

_____

_____

(1st SESSION)
Tick √ if used: ☐ Video ☐ Pamphlet

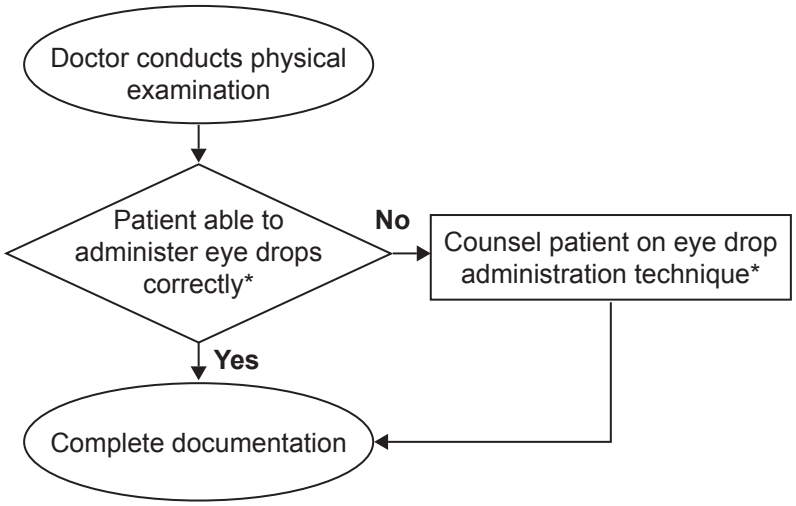
_____
Tandatangan
Nama & Cop Pegawai Farmasi
Tarikh:

(2nd SESSION)
Tick √ if used: ☐ Video ☐ Pamphlet

_____
Tandatangan
Nama & Cop Pegawai Farmasi
Tarikh:

Appendix 3

Flowchart of the process of care in the Ophthalmology Department



** indicates critical steps*

INCREASING THE PERCENTAGE OF ANTENATAL MOTHERS WITH ORALLY FIT STATUS IN TENGKERA DENTAL CLINIC, MELAKA TENGAH DISTRICT

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Abstract

Preventive, diagnostic and restorative dental treatments are safe to perform throughout pregnancy and are proven effective in improving and maintaining oral health. Despite being one of Malaysia's target groups for oral healthcare, the percentage of antenatal mothers achieving orally fit status remains low. A verification study was carried out from August 2018 to January 2019 to establish the baseline percentage of orally fit antenatal mothers and explore its possible contributing factors using structured questionnaires. This study aimed to increase the percentage of orally fit antenatal mothers in Tengkera Dental Clinic from 26.6% to at least 45% within two years. The contributing factors identified included a lack of committed dental practitioners, a lack of knowledge among dental officers, time constraints in completing all required treatments within the given time and a poor follow-up system. The remedial measures implemented from February 2019 until January 2021 incorporated continuous dental education (CDE) sessions, the formation of a dedicated team to ensure systematic follow-up, a referral letter system to address patients' logistic issues or their clinic preferences in getting treatment done and a WhatsApp BlueStacks application to ease and reinforce the follow-up process. Due to the COVID-19 pandemic amid this study, work processes were modified, and specific appointment slots were made to encourage dental appointment attendance while adhering to the new norms. This study shown an increase in the percentage of antenatal mother with orally fit status from 26.6% to 46.4% in Cycle 1, which gradually increased to 47.9% in Cycle 2 and 57.5% in Cycle 3, exceeding the standard set at 45%. These comprehensive multimodal interventional measures effectively increased the dental attendance of antenatal mothers and fostered the development of a local procedural guideline in Tengkera Dental Clinic to ensure continuous good oral health care services among antenatal mothers.

KEYWORDS: Antenatal mother, Orally fit, Dental attendance, Quality improvement study.

Problem

Good oral health is fundamental to the overall health and quality of life of pregnant women. Oral health care during pregnancy is often avoided and misunderstood as harmful by physicians, dentists and patients, despite evidence-based practice guidelines suggesting otherwise (1). Preventive, diagnostic and restorative dental treatments are safe throughout pregnancy and are proven effective in improving and maintaining oral health (2). Failure to maintain good oral health could result in periodontal diseases, increasing the risks of pre-eclampsia, preterm birth and low-birth-weight infants (1).

In Malaysia, multiple efforts were made to increase the dental attendance of antenatal mothers through referrals from the Maternal and Child Health (MCH) Clinics as part of the antenatal programme. This ensured that mothers who are considered agents of change would receive the essential oral health awareness and treatment to render them orally fit. Under this programme, oral treatments for antenatal mothers who are one of the target groups for oral healthcare, are rendered free in all public health clinics (3). However, the uptake of oral health care services among antenatal mothers remains unsatisfactory. According to the data published in 2018 by the Ministry of Health (MOH) Malaysia, only 47% of antenatal mothers who attended MCH Clinics had utilised oral health care services (4).

Tengkera Dental Clinic is a public dental clinic located within Tengkera Health Clinic premises, near the city centre in the Melaka Tengah district. According to a report published in 2018, it covers a population of 583 antenatal mothers (4). It consists of one dental restorative specialist, ten primary care dental officers, three dental nurses and six dental assistants. Four of the five dental treatment rooms available in Tengkera Dental Clinic are allocated for primary care, while one room is utilised by the dental specialist for specialised/ complicated treatments. Upon completing medical screening and follow-up in the MCH Clinic, patients will be directed to the dental team for dental check-ups and referrals for those requiring dental treatment. The primary care dental officers handle procedures such as dental restoration, scaling, simple extraction and simple root canal treatment. Certain complex cases are referred to the relevant procedure-based dental specialists. Although various efforts were implemented to improve the oral fitness of antenatal mothers, many were still presenting with oral diseases.

No national data was available on the prevalence of pregnant mothers with orally fit status. Preliminary data collected from August 2018 to January 2019 showed that only 23.7% of pregnant mothers were found to be orally fit in the state of Melaka, with 20.9% in the Melaka Tengah district. Based on the data, out of the nine public dental clinics in the Melaka Tengah district, Tengkera Dental Clinic had a prevalence of 26.6% of orally fit pregnant mothers, still below the initially set standard of 30% by the local authority. Furthermore, the Melaka State Dental Health Division revised the target to at least 45% in early 2019, which applied to all districts within Melaka.

Background

According to the expert consensus statement from Washington, it was concluded that dental care is both safe and effective throughout pregnancy, and women should continue receiving oral treatment during their pregnancy (5). It was also reported that antenatal mothers and all women, even those with healthy periodontium, whether before, during or after pregnancy, are recommended for routine dental assessments, as maintenance of good oral health is crucial (6).

A survey involving 781 pregnant women was carried out in Hong Kong, and only about one-third of the respondents perceived their oral health to be good. Self-reported dental visits were merely 16%, despite the presence of oral problems (7). Various studies from different countries have also reported a similar finding of low utilisation of dental care during pregnancy, which ranged from 27% to 53% (6,8-11).

According to previous studies,

the common contributing factors to low oral health care service utilisation among antenatal mothers included being unaware of the presence of oral health problems, long waiting time to get dental treatments, financial barriers, fear of dental procedures, and negative attitudes towards both the oral health care services available in general as well as dental care utilisation during pregnancy (12-15). Additionally, both dentists and antenatal mothers were found to be unsure of the safety of dental treatment during pregnancy, leading to their reluctance to provide and receive dental care (7,8,12-15).

Globally, numerous efforts have been introduced to promote oral health care to mothers and their children. To achieve desired outcomes from such health promotion, they should be carried out effectively at different levels across the socio-ecological system. This includes the intrapersonal level (attitude, beliefs, self-efficacy), interpersonal level (social norms, patient-provider communication), organisational level (prenatal and oral health clinics), community level (social and physical environmental barriers to prenatal oral health information and services) and societal level (health care access and reimbursement policies) (16).

At intrapersonal and interpersonal levels, several preventive measures, including fluoride varnish applications, mouth rinses with 0.12% chlorhexidine gluconate and professional oral hygiene, have been introduced and have significantly reduced dental caries by 56.58% and plaque score from 1.48 to 0.94 (17). At the organisational, community and societal levels, system-wide policy changes were introduced to improve inter-professional collaboration, such as explicit recommendations for prenatal oral health care from medical providers, effective mediation by social workers and implementation of recommended universal practice guidelines for community dental providers. Also, mobile applications and social media were used as innovative entry points, which improved the utilisation of prenatal oral health care (18).

In Florida, health promotion targeting the interpersonal and organisational levels was conducted among all pregnant mothers, including those in the postpartum period, through oral health discussions on the safety of dental procedures. Pregnant mothers were advised that early treatment of oral diseases is essential as delaying the treatment may lead to a more complex problem. Besides, obstetricians may also refer patients for oral health care with written recommendations or through calls (19). These strategies significantly improved the dental attendance of antenatal mothers, from 39% in 2009 to 55.2% in 2015 (20).

Measurement

This study measured the percentage of orally fit antenatal mothers based on the screening by dental officers in Tengkera Dental Clinic. An antenatal mother refers to a woman who carries a developing embryo or foetus within her body, usually about 40 weeks or over nine months, as measured from the last menstrual period up to delivery (21). All antenatal mothers attending clinic appointments at Tengkera Health Clinic, who consented to dental assessments, were recruited for this study. According to the Oral Health Division, MOH Malaysia, a person is defined to be orally fit when all necessary dental treatments are completed (22). Although the definition of the term “orally fit” was adopted from the MOH guidelines of Key Performance Indicators for school children, the same definition can also be applied in the context of assessing the oral fitness of antenatal mothers. The process of dental screening and assessing for dental fitness encompasses examining each tooth and the oral soft tissue and recording the findings accordingly.

Data from the Health Management Information System (HMIS) was used to calculate the percentage of antenatal mothers who were orally fit. The formula used to calculate the indicator used for this study is as follows:

$$\text{Percentage of antenatal mothers with orally fit status} = \frac{\text{Number of antenatal mothers who are orally fit}}{\text{Total number of antenatal mothers screened by dental officers}} \times 100\%$$

The indicator, i.e., the percentage of antenatal mothers with orally fit status, and its calculation formula were adopted from the measurement method proposed by the Oral Health Division, MOH Malaysia, which provided a clear representation of the study outcome (3,4). The standard for this study was to achieve 45% of antenatal mothers with orally fit status, following the standard of the Key Performance Indicator set by the Melaka State Dental Health Division.

The data collected from the HMIS during the verification study from August 2018 to January 2019 revealed that only 26.6% of antenatal mothers in Tengkera Health Clinic were orally fit. Following the verification study, the implementation of strategies for change started from February 2019 to January 2021, with the re-evaluations to assess the effectiveness of the strategies implemented being conducted concurrently and reported every 6 months (in total 4 times) till January 2021.

Initial Assessment of the Problem

The existing process of care related to operational procedures was reviewed and outlined. The process of care was divided into three phases: pre-dental assessment, during the dental assessment and post-dental assessment, with critical steps identified in each of these phases (refer to Figure 1).

Upon reviewing these critical steps, the problem was analysed to understand the possible contributing factors to the low percentage of antenatal mothers with orally fit status. The contributing factors identified were (i) a lack of committed dental practitioners, (ii) a lack of knowledge among dental officers, (iii) time constraints in completing all required treatment within the given time and (iv) a poor follow-up system.

A closed-ended online self-administered survey via Google Form was distributed among the dental practitioners in Melaka (n=97) to determine the magnitude of the identified contributing factors. The questionnaire consisted of four domains representing the four identified contributing factors, with a total of eight multiple-choice questions: three under factor (i), two under factor (ii), one under factor (iii) and two under factor (iv).

Regarding the factor of a lack of committed dental practitioners, 53.6% of the respondents were unclear about the national oral health Key Performance Indicator related to antenatal mothers, and 30.9% were unaware of the current percentage of antenatal mothers with orally fit status at their clinics. A total of 50.5% of dental practitioners self-perceived themselves as lacking soft skills to counsel antenatal mothers. For the factor of a lack of knowledge among dental officers, being unsure of the safety of dental treatment on antenatal mothers was rated as the highest at 92.8%, while 10.3% of the respondents reported that they were uncertain of the safety of dental screening during pregnancy, which indirectly affected their confidence when managing such cases. For the domain of time management, 45.5% of the respondents agreed that the complexity of treatment contributed to the time constraints in completing all required dental treatments within the given time. 61.9% of the respondents felt that the current follow-up system was inefficient and that there was also no proper referral system.

Strategy

Several strategies were identified to address the contributing factors to the low percentage of antenatal mothers with orally fit status in Tengkera Dental Clinic. These strategies were implemented over three cycles, from February 2019 to January 2021.

Plan-Do-Study-Act (PDSA) Cycle 1: First, a one-hour Continuous Dental Education (CDE) session was organised for the dental officers in Tengkera Dental Clinic. Before the CDE session was conducted, a pre-

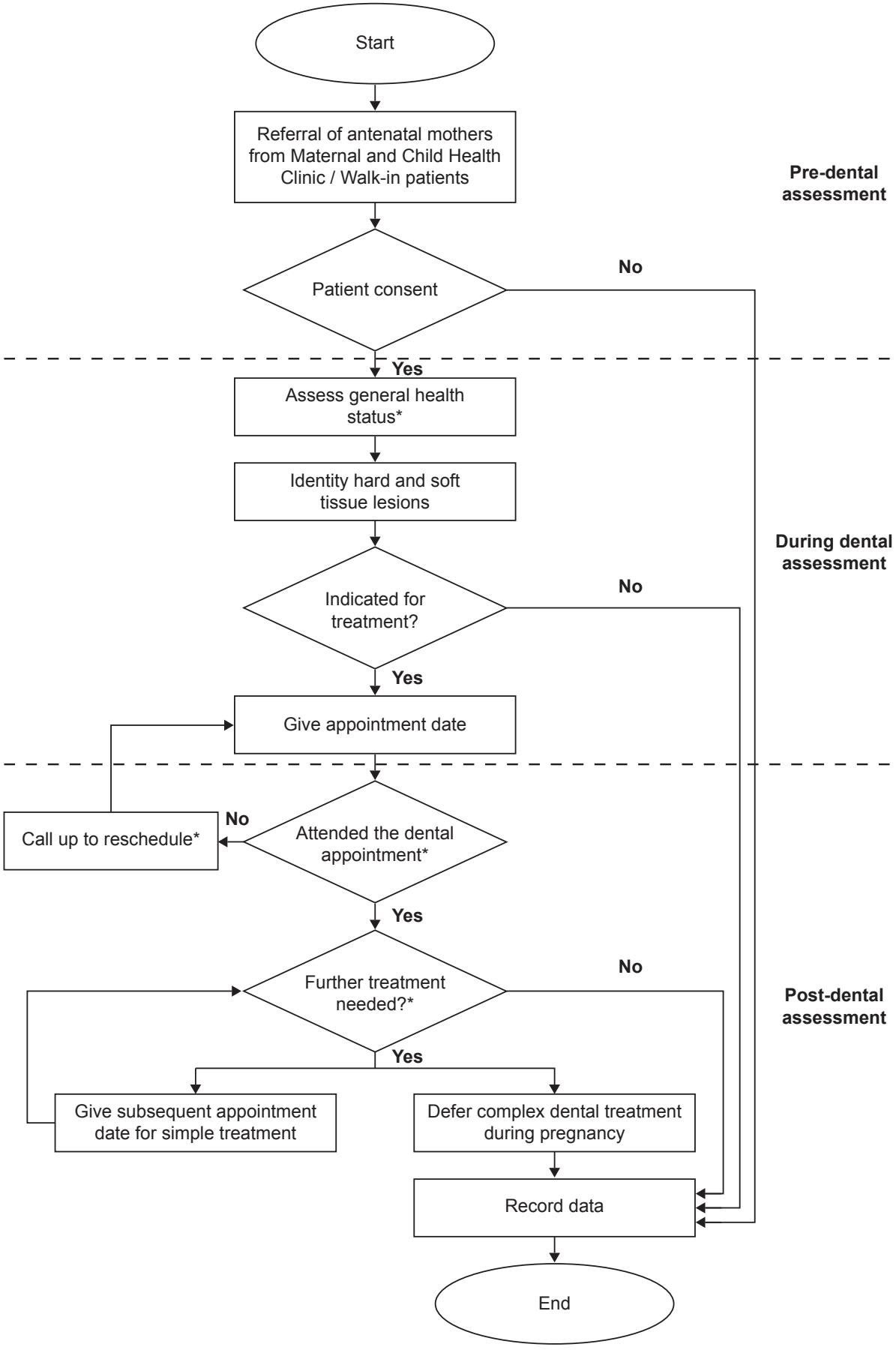

Figure 1: Process of care of operational procedures for oral health assessment and management (* indicates critical steps)

assessment with multiple-choice questions was conducted to evaluate the dental officers' baseline knowledge on (i) Part 1: the target standard for antenatal mothers with orally fit status, (ii) Part 2: the latest percentage of antenatal mothers with orally fit status in Tengkera Dental Clinic, (iii) Part 3, 4 and 5: the safety to perform dental screening and treatment for antenatal mothers, as well as the perceived confidence level in persuading antenatal mothers to go for dental treatment. Each part of the assessment was evaluated separately, with dental officers being graded "good" for each correct answer chosen in Parts 1 and 2 and the answer "Yes" in Parts 3, 4 and 5. They were graded "poor" for the wrong answer selected in Parts 1 and 2 and the answer "No" or "Not sure" in Parts 3, 4 and 5.

During the CDE session, information on the latest proposed standard for antenatal mothers with orally fit status, the current percentage of antenatal mothers with orally fit status in the clinic (both yearly and monthly data), as well as the latest update on the dental management guidelines for antenatal mothers were shared as reminders to the dental officers. CDE sessions were conducted every six months. The same assessment was performed after each CDE session as a post-assessment to evaluate their understanding of the session.

A subsequent monthly update on the percentage of antenatal mothers with orally fit status in the clinic was posted in a WhatsApp group created for dental officers as a reinforcement. The CDE sessions and WhatsApp group were created to counteract the knowledge gap among the dental officers, keeping them updated with current evidence and strengthening their commitment in managing antenatal mothers.

Secondly, a follow-up system was implemented to establish a systematic process and to encourage dental appointment attendance. Using this system, every dental officer assigned to the MCH department was required to screen antenatal mothers. The particulars of the screened antenatal mothers were recorded in a digital database and divided among the ten dental officers in Tengkera Dental Clinic. The assigned dental officer was responsible for calling the antenatal mothers under their care to arrange for their required dental treatment.

Besides the follow-up system, a referral letter system was also developed to address logistical issues. For patients who had another preferred clinic, a referral letter that included a dental referral form and a reply form was given to the patient. The patient was required to return the reply form to the dental officer on duty during her monthly check-ups at the MCH Clinic, which contained the details of the particular tooth that was treated and the dental clinic in which the treatment was performed. To keep track of the status of the referral letters issued, the dates of issuance of the referral letters and the dates on the returned reply forms were recorded in the same Excel database. However, a low return rate of the reply form was noted in this study.

In addition, a WhatsApp BlueStacks application, which is an Android emulator, was used in this study to ease and reinforce the follow-up process. This enabled the use of the application on a desktop computer without having to use a smartphone. Hence, it facilitated interaction with patients and further improved the effectiveness of dental appointment reminders. This application was also used to circulate promotional tools, such as videos or poster infographics. Nonetheless, a phone call reminder was still provided for antenatal mothers without access to the Internet, smartphone or computer.

PDSA Cycle 2: In Cycle 2, another intervention was introduced to adapt to service restrictions following the Coronavirus disease 2019 (COVID-19) outbreak in February 2020 to ensure the continuation of dental services to pregnant mothers. The dental appointment attendance of antenatal mothers to the clinic decreased during the COVID-19 pandemic as they were apprehensive of the infection risk. After a comprehensive discussion, it was decided that specific appointment slots would be allocated for pregnant mothers

with treatment needs, which was set for every Friday morning. The dental officers were strongly encouraged to complete all the treatments needed within that single allocated slot to prevent repeated clinic visits. However, if multiple types of treatments for one person (e.g., tooth restoration, tooth extraction and scaling) or a single type of treatment that involved multiple teeth (i.e., restoration of more than five teeth) were indicated, a subsequent appointment was arranged. The remaining pending treatment (if any) was updated in the database and followed up by the dental officer-in-charge.

PDSA Cycle 3: The interventions carried out in Cycle 1 and Cycle 2 continued to be monitored, evaluated and measured in Cycle 3 to ascertain sustainability. No further interventions were introduced during this cycle.

Results

The remedial actions implemented from February 2019 to January 2021 showed an increased percentage of antenatal mothers with orally fit status in Tengkera Dental Clinic from the baseline of 26.6% to 46.4% in Cycle 1, gradually increasing to 47.9% in Cycle 2 to a further 57.5% in Cycle 3 (refer to Figure 2). All three cycles had surpassed the set standard of 45%.

In this study, data was obtained from the HMIS system which is specifically designed and used as a routine transaction tool for patients who attended health facilities in Melaka; hence, there was no missing data.

Through the implementation of CDE, a significant increment was seen in the level of self-perceived confidence in persuading antenatal mothers to go for dental treatment (refer to Table 1), leading to improvement in assessing the general health status of the antenatal mothers, as reflected in Table 2. This was important because the step of assessing the general health status was the first step of contact with the antenatal mothers. Additionally, the dental officers were observed to have increased knowledge of the standard set for orally fit antenatal mothers and the monthly percentage of antenatal mothers with orally fit status in Tengkera Dental Clinic.

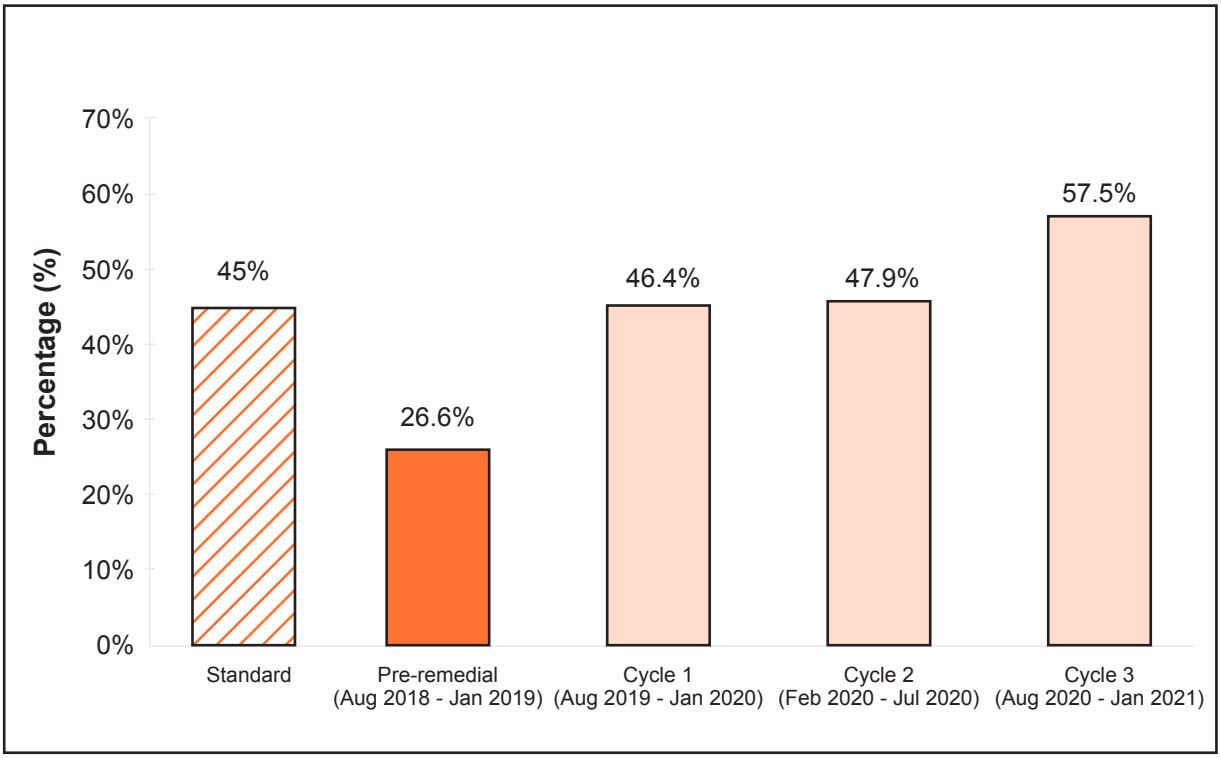

Figure 2: Percentage of antenatal mothers with orally fit status in Tengkera Dental Clinic

Table 1: Dental officer assessments in Tengkera Dental Clinic

Criteria		Pre-CDE		Post-CDE Cycle 1		Post-CDE Cycle 2		Post-CDE Cycle 3	
		Good	Poor	Good	Poor	Good	Poor	Good	Poor
Knowledge of the target standard of antenatal mothers with orally fit status		60%	40%	100%	0%	100%	0%	100%	0%
Awareness of the current monthly percentage of antenatal mothers with orally fit status in the clinic		50%	50%	100%	0%	100%	0%	100%	0%
Level of self-perceived confidence in persuading antenatal mothers to go for dental treatment		40%	60%	90%	10%	90%	10%	100%	0%
Knowledge on	Safety to perform dental screening during pregnancy	90%	10%	100%	0%	100%	0%	100%	0%
	Safety to perform dental treatment during pregnancy	80%	20%	90%	10%	100%	0%	100%	0%

Table 2: Model of Good Care on dental treatment among antenatal mothers in Tengkera Dental Clinic

Critical step	Criteria	Standard	Pre-remedial (Aug 2018 - Jan 2019)	Cycle 1 (Aug 2019 – Jan 2020)	Cycle 2 (Jan - Jul 2020	Cycle 3 (Aug 2020 - Jan 2021)
Assess general health status	• Assess the medical history and the willingness of the patient to commit to dental treatment • Encourage patients for dental treatment, especially during the early stage of oral diseases, to prevent complex dental treatment (if any) • Provide oral health education concurrently	100%	20.7%	76.3%	78.5%	60.7%
Attended the dental appointment	• Call patients as a reminder a day before the appointment • Patients turn up for their appointment	100%	9.8%	47.6%	62%	69.2%
Call up to reschedule	• Call patients to reschedule if they failed to attend their appointment to ensure a continuous follow-up process	100%	18.2%	28.7%	52.4%	73.6%
Further treatment needed	• Complete all the required treatments in a single visit • Arrange another appointment date for the patient if all the treatment needed cannot be attended to in a single visit and further simple treatment is needed (filling, scaling)	0% (Due to the COVID-19 case surge, dental officers were required to attempt to complete all the treatment needs in a single setting to avoid repeated dental visits, hence, a standard of 0% for patients needing further treatment.)	15%	7.1%	4.8%	1.8%

As shown in Table 2, only 20.7% of antenatal mothers agreed to be assessed and received oral health education in the pre-remedial phase. After the implementation of remedial actions, the percentage increased to 76.3% in Cycle 1 and 78.5% in Cycle 2. However, the percentage decreased to 60.7% in Cycle 3 due to the unexpected challenge of the COVID-19 pandemic which caused fewer antenatal mothers to present to the dental clinic for the first time for their initial dental screening.

Nevertheless, there was a sustainable improvement in the dental appointment attendance of antenatal mothers who agreed to be given appointments after their initial screening, during which they were identified to require dental treatment. It had improved from a mere 9.8% in the pre-remedial phase to 47.6% in Cycle 1, to 62% in Cycle 2 and finally up to 69.2% in Cycle 3. This improvement was the fruit of the effort from the dental officers in reminding and rescheduling appointments, in addition to the efficient reinforcement of follow-up appointments with the usage of the WhatsApp BlueStacks application.

With the surge of COVID-19 cases, specific appointment slots were arranged for antenatal mothers. Repeated clinic visits were avoided by completing all dental treatments required in a single visit, whenever possible, to reduce the risk of exposure to COVID-19. Moreover, the dental officers with good knowledge and soft skills enabled the timely detection of dental diseases and treatment at an earlier stage, hence, reducing the need for complex treatments such as minor oral surgery and root canal treatments thereby reducing the percentage of the deferment of complex dental treatments.

Lessons and Limitations

It was evident from this study that a proper management system and standardisation of dental treatment procedures for antenatal mothers were crucial to render them orally fit. The assembly of a dedicated team with unwavering commitment from the dental fraternity encouraged strong communication, which was the foundation for the success in exceeding the target set for this study.

However, this study did face several limitations. For instance, complex dental treatments that needed to be deferred, such as minor oral surgery, root canal treatment or any treatments involving X-rays, were among the challenges encountered. These complex procedures often require prolonged treatment durations, may need a prescription of drugs with potential teratogenicity and may involve the use of X-rays, which patients are usually hesitant to do despite safety precautions. Other than that, certain complicated dental treatments could not be carried out, for example, those that were beyond the capabilities of the primer clinic and required a dental specialist.

The study findings suggested that most interventions implemented were effective, except for the referral letter system. The setback of the referral system was the low return rate of the reply form, possibly due to the lack of time and logistic difficulties in returning the reply form. However, this strategy may be improvised in the future by establishing a proper digital platform or email system.

An unanticipated challenge faced amid this study was the COVID-19 pandemic. The pandemic caused reluctance among some antenatal mothers to attend dental treatment due to the fear of the risk of transmission of the virus as a result of the aerosol and splatter produced during dental drilling, which is commonly contaminated with bacteria, viruses, fungi and blood. In this regard, dental officers played a crucial role in educating and convincing the antenatal mothers that such Aerosol Generating Procedures would be performed using full Personal Protective Equipment, hence, significantly reducing the risk of transmission.

Antenatal mothers themselves also played a pivotal role in this study. Despite the multiple interventions carried out to address the issues of healthcare workers and the system, there were still some persistent limitations

attributed to the individual cooperation, perspective and attitude of antenatal mothers towards dental care.

Conclusion and the Next Steps

The success of this study prompted the development and implementation of a local procedural guideline in the routine workflow for dental care among antenatal mothers. The guideline incorporates the interventional strategies adopted in this study, i.e., the CDE program, the improved follow-up system, the referral letter system, the WhatsApp BlueStacks application and the allocation of specific appointment slots for antenatal mothers. A possible indirect advantage of these strategies is that the costs for oral health care, in general, may be reduced as major procedures can be avoided through early recognition and treatment of oral diseases.

In addition to the common contributing factors identified in our literature review, this study revealed additional factors specific to the local setting, i.e., the lack of a proper follow-up system and also a referral system between dental clinics. To counteract the mentioned contributing factors, the systematic follow-up process proposed in our study was a success. However, the referral system implemented showed an unfavourable result. An established digital platform or an email system can be considered and developed in the future to replace the use of physical referral letters to improve the return rate of the referral letter. A paperless process would be more cost-effective and environmentally friendly.

Given the promising results, it would be beneficial for the knowledge gained and strategies implemented in this study to be shared and adopted among the dental clinics in the state. We recommend assigning a dental officer as the coordinator in each public dental clinic to ensure the sustainability, standardisation of the implementation as well as conduct regular performance audits of the study project. Nevertheless, the success in replicating this study will depend on the allocation of dental treatment rooms and dental officers in respective clinics. We also suggest that the Melaka State Dental Health Department periodically reassess and revise the standard for antenatal mothers with orally fit status.

In the future, we suggest a similar study to be carried out with a focus on the efficiency of the enforcement of guidelines proposed by the MOH Malaysia, which states that all pregnant women attending MCH Clinics for antenatal care should be referred to a dental clinic for oral health examination and education (3). Proper enforcement will encourage the cooperation and compliance of antenatal mothers towards dental care.

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Conflict of interest

The authors declare that there was no conflict of interest

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IMPROVING THE APPROPRIATE PRESCRIBING OF PROTON PUMP INHIBITORS (PPI) AMONG REFERRED PATIENTS IN HEALTHCARE CLINICS UNDER THE HEALTH OFFICE OF KLANG DISTRICT

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Abstract

Proton pump inhibitors (PPIs) are prescribed for acid-related gastrointestinal disorders. However, inappropriate prescribing of PPIs may cause serious side effects, such as community-acquired pneumonia, bone fracture and *Clostridium difficile* infection. Additionally, it results in unnecessary healthcare costs. This study aimed to improve the appropriateness of PPI prescriptions to at least 66% within a four-month intervention period. A quality improvement study was conducted in 12 health clinics with resident pharmacists under the Health Office of Klang District (HOKD) in March 2018. All prescriptions of PPIs were assessed except for *Sistem Pendispensan Ubat Bersepadu* (SPUB) prescriptions from external facilities. A pre-interventional data review of 284 PPI prescriptions received in March 2018 showed that only 1.76% (n=5) was deemed appropriate. The contributing factors identified included lack of interventions by clinicians and pharmacists, incomplete indications of PPIs on prescriptions, insufficient PPI information on discharge letters and lack of assessment guidelines. In this study, the pharmacist review form (PRF) on PPIs was designed as the intervention tool for the screening process; PPI educational training sessions were conducted for clinicians and pharmacists; counselling checklists and patient education leaflets were developed to improve the effectiveness of the counselling sessions; and algorithm of PPI deprescribing was developed for practice by clinicians. Moreover, project findings were shared with Tengku Ampuan Rahimah Hospital to increase awareness of issues related to incomplete documentation of PPI prescriptions in discharge summaries and referral letters. In July 2018, the percentage of appropriate PPI prescriptions had increased from 1.8% (n=5/284) to 69.8% (n=487/698), and subsequently to 91.9% (n=124/135) by 28th February 2019. In conclusion, continuous intervention implementation and regular monitoring of outcomes prevent potential PPI side effects and unnecessary healthcare costs.

KEYWORDS: Proton pump inhibitor, Primary care, Appropriate use, Quality improvement study

Problem

Proton pump inhibitors (PPIs) are used to treat gastro-oesophageal reflux disease, peptic ulcer disease, Helicobacter pylori infection, and Zollinger-Ellison Syndrome, as well as to prevent nonsteroidal anti-inflammatory drug (NSAID) induced ulcers for 4 to 12 weeks or longer depending on diagnosis (1). Although PPIs are considered safe in general, inappropriate prescribing of PPIs, including improper indication, dose, frequency and duration, may lead to severe side effects like community-acquired pneumonia, bone fracture, Clostridium difficile infection and renal dysfunction (2). Besides, inappropriate prescribing of PPIs may result in increased and unnecessary healthcare costs (3). In 2017, there were a total of 1,407 inappropriate PPI prescriptions from all healthcare clinics under the Health Office of Klang District (HOKD). As a result, an unnecessary expense of approximately MYR390,333.22 (USD92,737.79) was wasted on PPIs that year.

Klang district is one of the largest districts in Selangor, Malaysia and serves a high-density population estimated at 842,146 people. There are 12 healthcare clinics in the Klang district providing outpatient services. These health clinics are operated by 1,209 healthcare workers, including six family medicine specialists (FMS), 202 medical officers, 60 pharmacists and paramedics respectively, as well as other supporting staff (refer to Appendix 1).

Multiple ambulatory care services are delivered to the community through healthcare clinics for walk-in and hospital-referred patients. Three clinics under the HOKD provide extended-hour (EH) services after working hours, where patients with acute illnesses may walk in to seek treatment. Patients may also get their prescriptions refilled at the pharmacy. The pharmacy department plays a vital role in healthcare clinics where all prescriptions are screened, medication errors are intervened, medicines are dispensed, drug inventories are managed and counselling is given to patients.

The PPIs are categorised under "group A prescriber drugs", which are drugs that cannot be started by FMS and only can be initiated by physicians with specialities in hospitals. Patients needing PPIs will be referred to healthcare clinics for further clinical management once their conditions are stable. In healthcare clinics, FMS and medical officers may continue to prescribe PPIs for hospital-referred patients after clinical assessments only if the medicines are recorded on the patients' referral letters or discharge summaries, which will be brought along by patients during their first clinic visit.

The process of care in prescribing PPIs involves both clinicians and pharmacists. Therefore, an FMS with pharmacists from different healthcare clinics under the HOKD formed this Quality Assurance (QA) team to construct practical interventions for reducing inappropriate PPI prescriptions.

In March 2018, a pre-intervention study conducted in 12 health clinics under the Klang district showed that 98.2% (n=279/284) of the PPI prescriptions received at the pharmacy departments were inappropriate (without definitive indications, durations, doses and frequencies of PPI therapies). This QA project was designed to improve the percentage of prescriptions with appropriate prescribing of PPIs in all health clinics under the HOKD from 1.8% to at least 66% within a four-month intervention period.

Background

PPIs are commonly used at higher doses and more prolonged than necessary. Such misuse leads to overprescribing in both primary and tertiary care centres. In the United States, the number of visits with documented PPI use increased from 30 million in 2002 to 84 million in 2009, of which 62.9% had inappropriate medical indications (4). In Germany, 54.5% (n=371) of discharge letters from 35 hospitals showed inappropriate indications for continuous PPIs treatment and the indications in 12.7% (n=47) of their discharge letters were uncertain (16). Additionally, Lodato et al. (21) compared the initiation and continuation of PPIs in Italy at three different points: hospital admission,

hospitalisation and discharge. The study found that one-third of the patients had an inappropriate prescription of PPIs.

Another study conducted at a tertiary teaching hospital in Singapore showed that 81.2% (n=65) of 150 consecutive patients aged ≥65 years who had been admitted had no valid documented indications of PPI neither in case notes or physician discharge summary (5). In Malaysia, a local study conducted in a tertiary hospital in Pahang stated that 49% (n=323) of patients were inappropriately prescribed with PPIs in the ward and continued with PPI treatment during discharge. Among the patients, 51% (n=165) continued receiving PPIs at discharge without a documented indication. On the other hand, 55% (n=363) of patients were prescribed with PPIs appropriately during hospitalisation but were discharged with PPIs unnecessarily (6). Likewise, another local study conducted in Serdang Hospital by Rufah et al. (7) showed that 46% (n=343/746) of patients were inappropriately prescribed with PPIs.

Looking into the duration of PPI treatment, Giannini et al. (8) found that more than half of the patients in the study were on PPIs for at least two years, of which 25% (n=63) among them were treated for more than five years with PPIs and 35.4% (n=88) of them needed deprescribing of PPIs. Another study conducted at Irish Regional Hospital showed similar findings, in which 45% (n=112) of their patients were on PPI treatment for at least two years and 27.3% (n=68) of them continued their PPI treatment for more than sixty months (9). A quality improvement project conducted at a few university hospitals in New York reported that 30% (n=54) of patients had inappropriate use of PPIs for an average of four to five years, of which 51.1% (n=92) needed to be discontinued from PPIs (11).

Inappropriate use of PPIs will lead to unnecessary high expenditure under the health care system. A study in the United States found an unnecessary cost of up to USD3,013,069 for PPIs prescribed inappropriately during hospital discharge (18). Another study by Nallapeta et al. (11) showed a direct cost savings of USD13,992 annually from PPI discontinuations. On the other hand, the total utilisation of medicines for acid-related disorders in Malaysia had increased from 2.9550DDD per 1,000 population per day in 2007 (19) to 6.5802DDD per 1,000 population per day in 2009, and to 6.7124DDD per 1,000 population per day in 2010 (20). Reducing inappropriate prescribing patterns of PPIs in outpatient settings can minimise potential adverse events and avoid unnecessary costs.

Regarding the side effects, the United States Food and Drug Administration (FDA) issued safety warnings regarding the long-term use of PPIs in 2010 (12). A systematic review and meta-analysis conducted in 2015 by Cheungpasitporn et al. (13) concluded that approximately 40% (n=43,919) increased risk of hypomagnesemia with PPI use compared with non-PPI use. In 2015, the FDA issued a public safety alert about 74% (n=231,620) increased risk of developing Clostridium difficile infections (14) and 34% (n=106,420) increased rate of pneumonia (15) in long-term use of PPI. A study conducted by Ahrens et al. mentioned that 50% (n=341) of patients in primary care with inappropriate use of PPIs could cause a range of side effects, such as the increased risk of enteric infections (including Clostridium difficile-associated diarrhoea), community-acquired pneumonia, bone fracture, nutritional deficiencies and interference with the metabolism of antiplatelet agents (16).

In regard to the inappropriate use of PPIs, intervention by pharmacists plays a role in reducing the inappropriateness of PPI prescribing. A study from Bundeff reported that during interventions by clinical pharmacists, 37.6% (n=44) of patients had started the PPIs taper protocol recommended by their primary care providers (10).

In a quality improvement project by Nallapeta et al., the inappropriateness of PPI usage was reduced from 80% (n=144) to 60% (n=108) by creating an electronic patient registry from electronic health records. It was designed for clinicians to assess PPI therapies, including document indications, risk assessments, dose reductions and

discontinuations. Besides, the study also mentioned that weekly educational sessions were carried out for all clinicians to enhance their knowledge and awareness of the appropriateness of PPI prescribing. Furthermore, pamphlets regarding side effects and appropriate risk reductions of PPIs were developed and handed to patients to create awareness of proper PPI use (11).

Measurement

The primary outcome of this study was to increase the percentage of appropriate PPI prescriptions among patients in all 12 health clinics under the HOKD. The indicator for an appropriate PPI prescription was the percentage of prescriptions with correct indications, doses, durations and frequencies of PPIs among patients. The percentage was calculated as the total number of prescriptions with appropriate prescribing of PPIs over the total number of prescriptions with PPIs. All prescriptions of PPIs received during working hours were included in the study except for *Sistem Pendispensan Ubat Bersepadu* (SPUB) prescriptions from other facilities because the clinical management of these patients was still under the referred facilities. The SPUB is a follow-up medication supply service through prescription referrals, in which patients can obtain a supply of their medications from the Ministry of Health facilities (22). Furthermore, prescriptions received during EH were excluded as well because there were no in-house pharmacists and doctors during EH on certain days.

All PPI prescriptions collected at the screening counters in the pharmacy departments were evaluated based on the indicator of this study. The status of PPI indication, duration, dose and frequency in each prescription received were documented in an audit checklist. A pre-intervention study in March 2018 showed that only a tiny fraction of PPI prescriptions at 1.8% (n=5) out of 284 PPI prescriptions received were appropriate. Based on published literature from Lodato et al. (21), the QA team in this study proposed a standard that required a minimum of 66% of PPI prescriptions received at pharmacy counters in healthcare clinics to be appropriately prescribed.

Initial Assessment of the Problem

The process of care associated with assessing hospital-referred patients who walked into healthcare clinics under the HOKD is shown in Figure 1. The critical steps that may play a part in reducing the inappropriateness of PPI prescribing were highlighted with asterisks. The said processes were issuing the prescription, screening the prescription, referring to the clinician or requesting for patient's referral letter by pharmacists during interventions, as well as dispensing and counselling. These four processes were marked as critical steps because potential intervention strategies could be implemented to increase the appropriateness of PPI prescribing.

A problem analysis diagram was developed to identify the contributing factors to the inappropriate prescribing of PPIs (refer to Figure 2). According to the analysis, a few factors were detected, including an incomplete prescription indication by clinicians, a lack of clinicians' and pharmacists' intervention and incomplete PPI information in referral letters. A verification study was conducted in March 2018 to assess all PPI prescriptions (n=284) received at all pharmacy departments in healthcare clinics under the HOKD. The result revealed that 76.7% of prescriptions received were without indications for PPIs. Besides, the patients' referral letters were traced when they handed their prescriptions to the pharmacy screening counters. The result showed that 75% of the referral letters were incomplete with either the indication or the duration of PPIs. Moreover, 81.7% of the PPI prescriptions were not intervened by pharmacists.

A self-administered questionnaire to assess the knowledge and awareness amongst doctors and pharmacists on appropriate prescribing of PPIs was developed as such attributes may be the factors contributing to the incompleteness of information on the PPI indications in the treatment and the lack of intervention. The

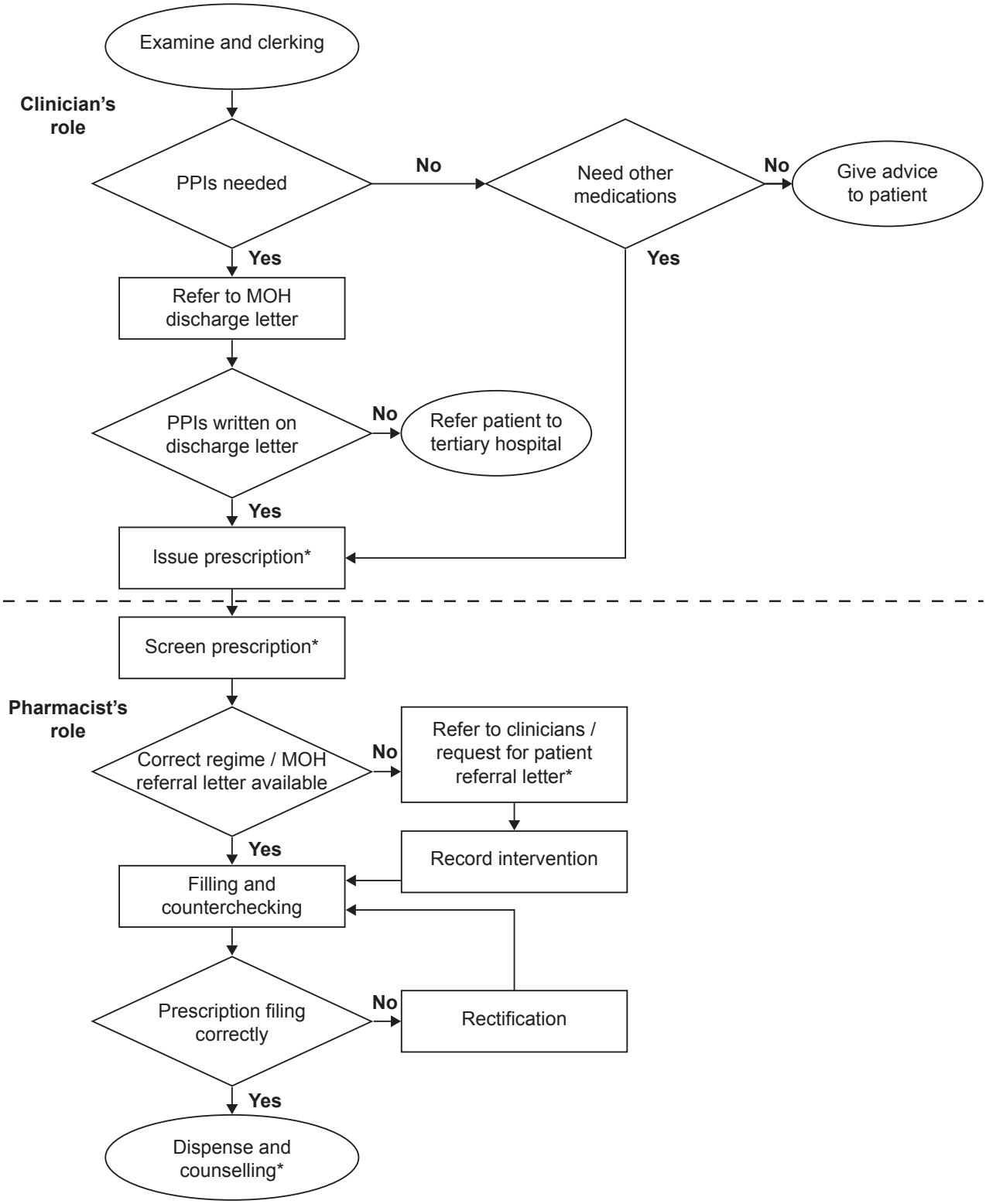

Figure 1: Flowchart of the process of care of prescribing proton pump inhibitors in healthcare clinics during pre-intervention phase (* indicates critical steps)

questionnaire was distributed to a total of 120 respondents during the pre-intervention phase to identify contributing factors leading to the problem and post-interventions to evaluate the effectiveness of the intervention. Only 45% (n=54) of the respondents achieved a passing mark of 80% and above in the pre-intervention phase. Most respondents failed to identify the anticipated PPI treatment duration, possible PPI side effects, and use of concomitant medicines that may cause gastrointestinal symptoms and drug interactions.

Strategy

Two PDSA (plan, do, study, act) test cycles were performed in this study. Three improvement strategies were implemented during Cycle 1 (July until September 2018). In this cycle, the aim was to increase the

Figure 2: Problem Analysis Chart of contributing factors to the low percentage of the appropriate use of PPI among patients in the primary care setting.

appropriateness of PPI prescribing by enhancing interventions and counselling services in pharmacy departments. The contributing factors of inappropriate PPI prescribing were studied and remedial actions were carried out. The lack of pharmacists' interventions and incomplete indications in prescriptions by clinicians were identified as the contributing factors.

Thus, as the first strategy, a Pharmacist Review Form (PRF) (refer to Appendix 2) with 15 questions was developed for pharmacists to interview patients prescribed with PPIs when the prescriptions were handed over to the screening counter. The first part of the PRF (Q1-Q6) was about patients' current PPI regime, which comprised of indication, dose, frequency and duration of PPIs as well as adverse effect profile. The second part (Q7-Q10) was about patients' concurrent medications and compliance issues, while the third part (Q11-Q15) was about interventions and counselling. The PRF served as a guide for pharmacists to initiate interventions on the PPI prescriptions received if any deprescribing of PPIs was needed. As a result, the flowchart of the process of care was updated with an additional intervention step by pharmacists (refer to Figure 3).

Secondly, PPI Training Modules were developed. Three face-to-face educational sessions on PPIs were delivered to 60 pharmacists during Cycle 1 to create awareness of appropriate PPI prescribing and enhance their knowledge of PPIs. The sessions focused mostly on introducing PPIs, their side effects, indications, doses and frequencies, as well as the PRF. The same questionnaire was used to reassess the participants' knowledge after the educational sessions. Besides, a counselling checklist and guide about PPIs were developed for pharmacists to counsel patients regarding the dose, frequency, duration and side effects of PPIs during dispensing.

Thirdly, patient education leaflets about PPIs, including the long-term side effects, were distributed to patients to create awareness of the appropriate use of PPIs and encourage them to be self-responsible for their health conditions.

As a whole, the achievement after Cycle 1 was satisfactory. However, further interventions were carried out to achieve a better outcome. Therefore, the study continued with PDSA Cycle 2 (December 2018 until February 2019), where the clinician group was targeted to improve the prescribing processes and practices. The PPI Training Modules were proposed for FMS to conduct eight educational sessions on PPIs for clinicians from healthcare clinics under the HOKD to address the factor of incomplete indications of PPIs in prescriptions. Besides emphasising the pharmacology of PPIs, a deprescribing algorithm adopted from Farrel et al. (23) (refer to Appendix 3) was introduced to clinicians to guide them on stepping down the PPI therapies or terminating the treatment if the therapies were unnecessary.

Incomplete information about PPIs in referral letters was one of the main contributing factors to inappropriate PPI prescribing practices. However, this factor was beyond the control of this study because the referral letters were written by medical officers from the referred hospitals. In order to create awareness about the seriousness of inappropriate prescribing of PPIs in healthcare clinics, the results of Cycle 1 were presented on 16th November 2018 in one of the drug committee meetings at Tengku Ampuan Rahimah Hospital, Klang which was the main tertiary hospital with the most PPI referral cases to healthcare clinics under the HOKD. Additionally, to further create awareness of the inappropriate prescribing of PPIs to other hospitals in Selangor, the Cycle 1 results were shared during a creativity and innovation meeting at the Selangor State Pharmacy Department on 8th November 2018. All the Heads of Pharmacy Departments from Selangor attended the meeting. Besides that, the results were also shared at a mini-QA convention organised by Selayang Hospital on 19th July 2019. The event involved 75 participants, including medical officers, pharmacists, paramedics, nurses, lab technicians and nutritionists from different units within the hospital.

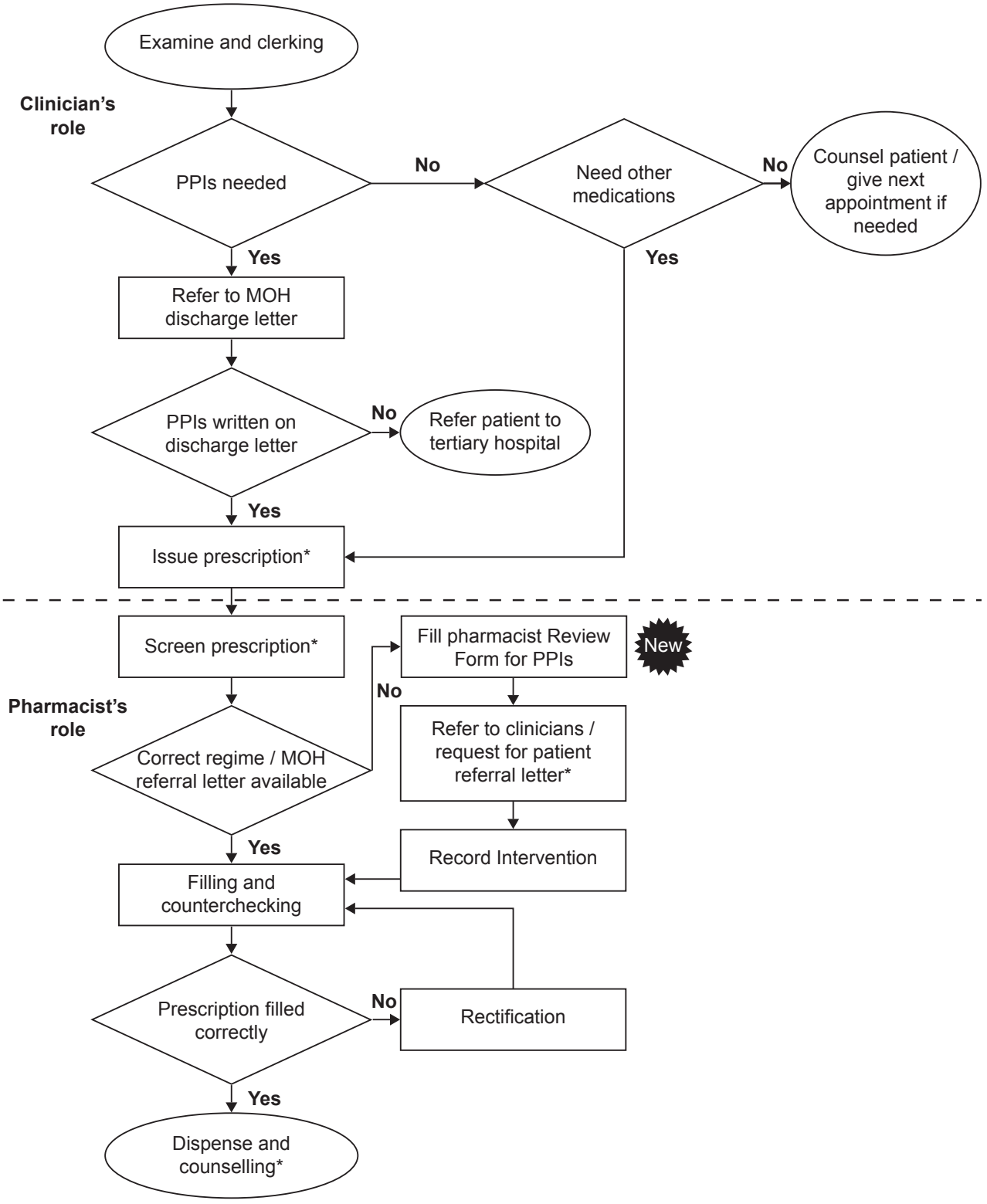

Figure 3: Flowchart of the process of care of prescribing proton pump inhibitors in healthcare clinics during the post-intervention phase (* indicates critical steps)

Results

Following several strategies, the percentage of prescriptions with appropriate prescribing of PPIs in the 12 health clinics increased sharply from 2% (n=5/284) to 70% (n=487/698) in Cycle 1 and further up to 92% (n=124/135) in Cycle 2. The achievable benefits not achieved (ABNA) reduced from 64% to -4% in Cycle 1 and further down to -26% in Cycle 2 (refer to Figure 4).

All standards set in the model of good care showed improvements from the verification study to Cycle 2 (refer to Table 1). The percentage of the criteria "to ensure indication of PPIs is written" increased from 24% to 30%, then further up to 90% throughout the cycles, while the percentages of the two criteria indicating the appropriateness of prescribing PPIs both increased drastically to 70% in Cycle 1 and further up to 92% in Cycle 2. Besides that, the percentage of patients' discharge letters complete with either the indication or duration of PPIs increased from 40% in Cycle 1 to 94% in Cycle 2. Last but not least, pharmacists' intervention rate on the inappropriateness of PPI treatment improved in both cycles.

The level of awareness among healthcare practitioners on the appropriate prescribing of PPIs improved after the interventions were implemented. A re-assessment of awareness among healthcare practitioners following the intervention showed an increase in passing marks to 94% (n=113). The cost saving was also calculated in 2017, whereby the initial unnecessary cost of PPIs was reduced from MYR390,333.22 (USD92,737.79) to MYR39,420.00 (USD9,362.31) in the following year.

Lessons and Limitations

In this study, it is learnt that engaging a multi-disciplined team is imperative to initiate and sustain a successful change. Both clinicians and pharmacists play an essential role in ensuring patients on PPIs receive optimal treatment with the lowest risk of unwanted side effects. Besides, healthcare professionals have started to be aware of the significance of reviewing all PPI cases referred from hospitals. Full commitment among healthcare professionals in this study

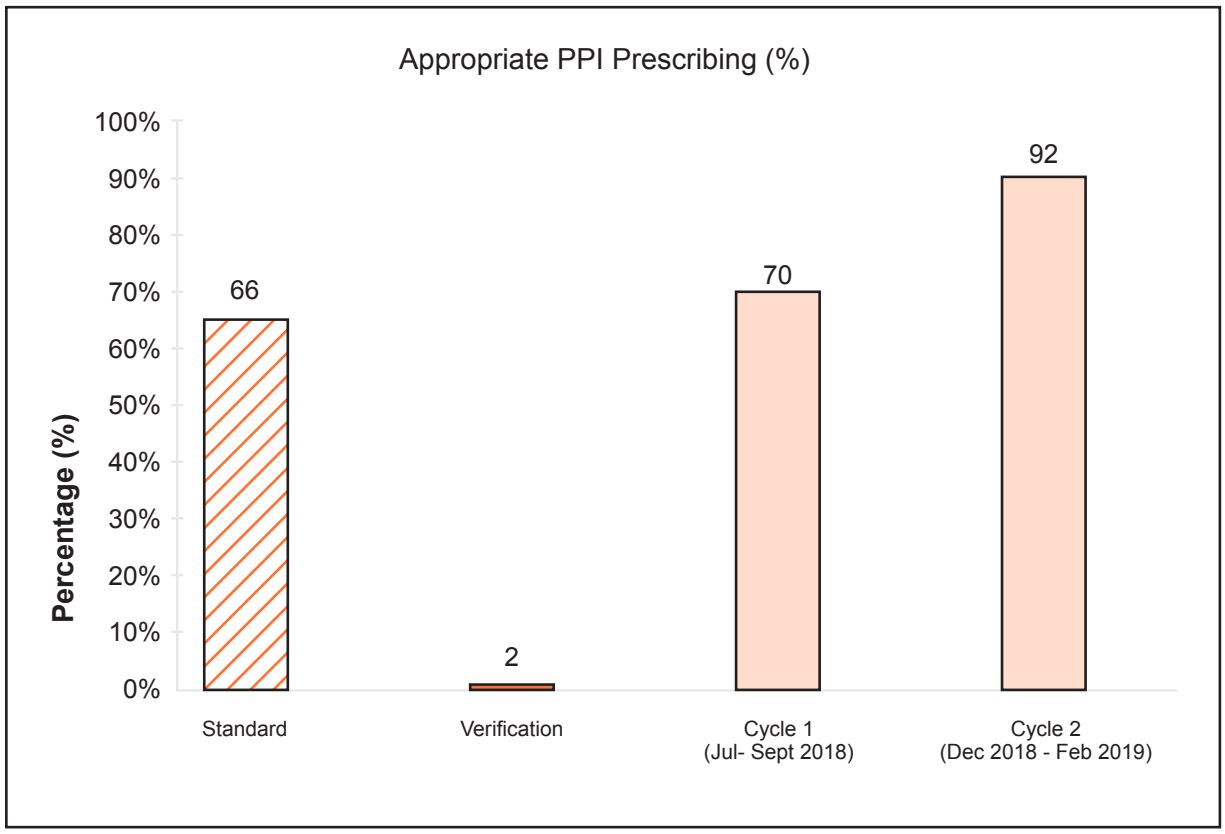

Figure 4: Percentage of appropriate proton pump inhibitors prescribed in healthcare clinics pre- and post-interventions

Table 1: Model of good care

Process	Criteria	Standard	Verification Study	Cycle 1	Cycle 2
1. Assessment	Assess the patient on the appropriateness of PPIs.	100%	4%	20%	95%
2. Issue Prescription	• To ensure the indication of PPIs is written.	100%	23%	30%	90%
	• To ensure the dose, frequency and duration of PPIs are written.	100%	96%	100%	100%
3. Screen Prescription	• To ensure the indication of PPIs is appropriate.	66%	2%	70%	92%
	• To ensure the dose, frequency and duration of PPIs are appropriate.	66%	2%	70%	92%
	• To ensure the patient has a complete MOH discharge letter with either indication or duration of PPIs.	100%	25%	40%	94%
4. Refer to the Clinician	Call the clinician for intervention if PPI treatment is not appropriate.	100%	18%	71%	98%
5. Dispense & Counselling	• Correct medications are dispensed.	100%	100%	100%	100%
	• Counseling is given to the patient.	100%	20%	100%	100%
	• Drug information leaflet is handed to the patient.	100%	0%	100%	100%

has resulted in the improvement of appropriate prescribing of PPIs. It helped patients achieve a better quality of life and reduce unnecessary healthcare costs.

Incomplete information in referral letters from tertiary hospitals was a challenge for this study because it involved third parties. However, the study achieved its purpose by highlighting the seriousness of inappropriate prescribing of PPIs and sharing the study outcomes.

Moreover, the limitation in this study, where patients' clinical data was not synchronised through information technology between healthcare clinics under the HOKD and hospitals, is acknowledged. For instance, a small group of walk-in patients came into the healthcare clinics with incomplete referral letters needed to continue their PPI therapies. In these cases, the medical officers could not trace back the history of the patients from the hospitals because the diagnoses were not documented in the referral letters. As a result, the patients had to be referred to hospitals because interventions could not be carried out under such circumstances.

Conclusion and The Next Step

In conclusion, the appropriateness of PPI prescribing must be assessed by clinicians to prevent serious side effects and avoid unnecessary costs. This study had achieved a standard with at least 66% appropriate prescribing of PPIs. This showed a sustainable improvement that exceeded the

target in subsequent cycles.

In the near future, the authors would like to empower the sustainability of the appropriate use of PPIs in primary care by ensuring adherence to deprescribing algorithms and guidelines across all disciplines, including doctors and pharmacists. Besides that, educational sessions will be carried out annually to include all new and existing staff. Furthermore, the improvement strategies in this study can also be shared and served as a reference for other facilities nationwide to adopt and adapt in their healthcare settings.

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Conflict of Interest

The authors declare that there was no conflict of interest.

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Appendix 1

Types of Clinics and Workload

Health Clinic	Number of FMS	Number of Medical Officer	Number of Pharmacist	Type of Clinic*	Average number of patients visit/day	Average number of prescription /days
Bandar Botanic Health Clinic	2	25	11	Type 1	760 - 800	850 - 900
Pandamaran Health Clinic	2	25	8	Type 2	600 - 700	650 - 700
Bukit Kuda Health Clinic	2	16	7	Type 2	420 - 450	500 - 600
Anika Health Clinic	0	12	6	Type 3	300 - 440	500 - 600
Pelabuhan Klang Health Clinic	1	11	3	Type 4	250 - 270	350 - 400
Kapar Health Clinic	1	15	5	Type 4	260 - 300	350 - 400
Meru Health Clinic	1	14	5	Type 4	300 - 350	350 - 400
Rantau Panjang Health Clinic	0	8	2	Type 5	140 - 150	170 - 230
Pulau Indah Health Clinic	0	5	2	Type 5	70 - 120	80 - 100
Pulau Ketam Health Clinic	0	2	1	Type 7	35 - 50	30 - 50
Bukit Naga Health Clinic	0	8	1	Type 6	50 - 90	70 - 100
Sungai Bertek Health Clinic	0	8	1	Type 4	150 - 200	150 - 200

*Type of clinic based on the average total number of patients visit per day; type 1 ; >800; type 2: 500-800; type 3: 300-500; type 4: 150-300; type 5: 100-150; type 6: 50-100; type 7: <50

Appendix 2

Pharmacist Review Form

PHARMACISTS REVIEW FORM
INTERVENTIONS ON APPROPRIATE USE OF PROTON PUMP INHIBITORS (PPIs)
PHARMACY DEPARTMENT PEJABAT KESIHATAN DAERAH KLANG

Ref No. *(filled by data compiler)*

1. Current Management

Which PPI is the patient using? Active ingredient (Brand name)	What is the current DAILY dose of PPI? e.g. omeprazole 20 mg twice a day = 40 mg/day								What is the dosing schedule of PPI?		
									OD / BD	prn	Not known
☐ Esomeprazole (Nexium)	☐		☐ 20 mg/daily		☐ 40 mg/daily		☐ Other		☐	☐	☐
☐ Lansoprazole (Zoton)	☐	15 mg/daily	☐ 30 mg/daily		☐ 60 mg/daily		☐ Other		☐	☐	☐
☐ Omeprazole (Acimax, Losec, Meprazol, Omepral, Probitor)	☐	10 mg/daily	☐ 20 mg/daily		☐ 40 mg/daily		☐ Other		☐	☐	☐
☐ Pantoprazole (Somac)	☐	20 mg/daily	☐ 40 mg/daily		☐ 80 mg/daily		☐ Other		☐	☐	☐

2. Indication and episode of care

Was the current PPI prescription?
☐ An initial prescription for PPI therapy
☐ Ongoing therapy (unchanged)
☐ A change to current therapy (e.g. increase/decrease dose, change to a different PPI)
☐ Not determined/not known

3. Was the indication of PPI written on prescription?

☐ Yes. If Yes, go to Q4
☐ No. Please intervene.

4. What was the clinical indication(s) for treatment with a PPI? (Mark all that apply)

☐ GORD/reflux/dyspepsia/heartburn	☐ Prophylaxis of drug–induced dyspepsia/ulceration. Please specify: ☐ Aspirin ☐ Conventional NSAID ☐ COX-2 selective NSAID ☐ Other
☐ Mild to moderate oesophagitis	
☐ Peptic ulcers (including NSAID or H. pylori–induced ulcers)	
☐ H. pylori eradication	
☐ Not known	
☐ Other _____	☐ Zollinger–Ellison syndrome ☐ Severe oesophagitis ☐ Barrett's oesophagus ☐ Strictures, scleroderma

5. How long has the patient been using a PPI?
☐ Not applicable (initial prescription)
☐ < 4 weeks
☐ 4–8 weeks
☐ > 8 weeks
☐ Not determined
☐ Not known

6. Are alarm symptoms present?
☐ Yes
☐ No
☐ Not determined
☐ Not known

Alarm symptoms
☐ Dysphagia (difficulty swallowing)
☐ Odynophagia (painful swallowing
☐ Nocturnal choking
☐ Melaena (tar/black stools)
☐ Unexplained weight loss
☐ Haematemesis (vomiting of bright red blood)
☐ Abdominal mass
☐ Anaemia

7. Was the patient using their PPI therapy as prescribed?
☐ Not applicable (initial prescription
☐ Yes, takes every day or as prescribed
☐ No, has not been using PPI as prescribed
☐ Not determined
☐ Not known

8. Was the patient using any medication that may induce/exacerbate dyspepsia/ulceration?
☐ Yes
☐ No
☐ Not determined
☐ Not known

9. Was the patient currently using any concomitant medication that alter gastric pH (e.g.: antacids, H2 antagonists)?
☐ Yes
☐ No
☐ Not determined
☐ Not known

10. Was the patient using any medication that may interact with a PPI?
☐ Yes
☐ No
☐ Not determined
☐ Not known

11. Did you determine if there are any factors (e.g. certain foods) that exacerbate the patient's symptoms?
☐ Yes
☐ No
☐ Nothing identified

12. Outcome
Mark any further actions to be implemented/have been implemented for this patient:
☐ refer patient to prescriber for review
☐ contact prescriber directly to discuss managem
☐ check adherence at next episode of care
☐ contact carer/relative/support person
☐ advice on specific lifestyle issues
☐ provide specific counselling (REFER COUNSELING CRITERIA)

☐ alarm symptoms present
☐ patient may be suitable for review/step-down in therapy
☐ use of medicine that may induce/ exacerbate GI symptoms
☐ potential drug interactions
☐ refractory symptoms

13. Pharmacist's recommendation
_____
_____
_____

14. Next step (Yes / No)
☐ Counseling given to the patient
☐ Patient's information leaflet (PIL) given

Completed by,

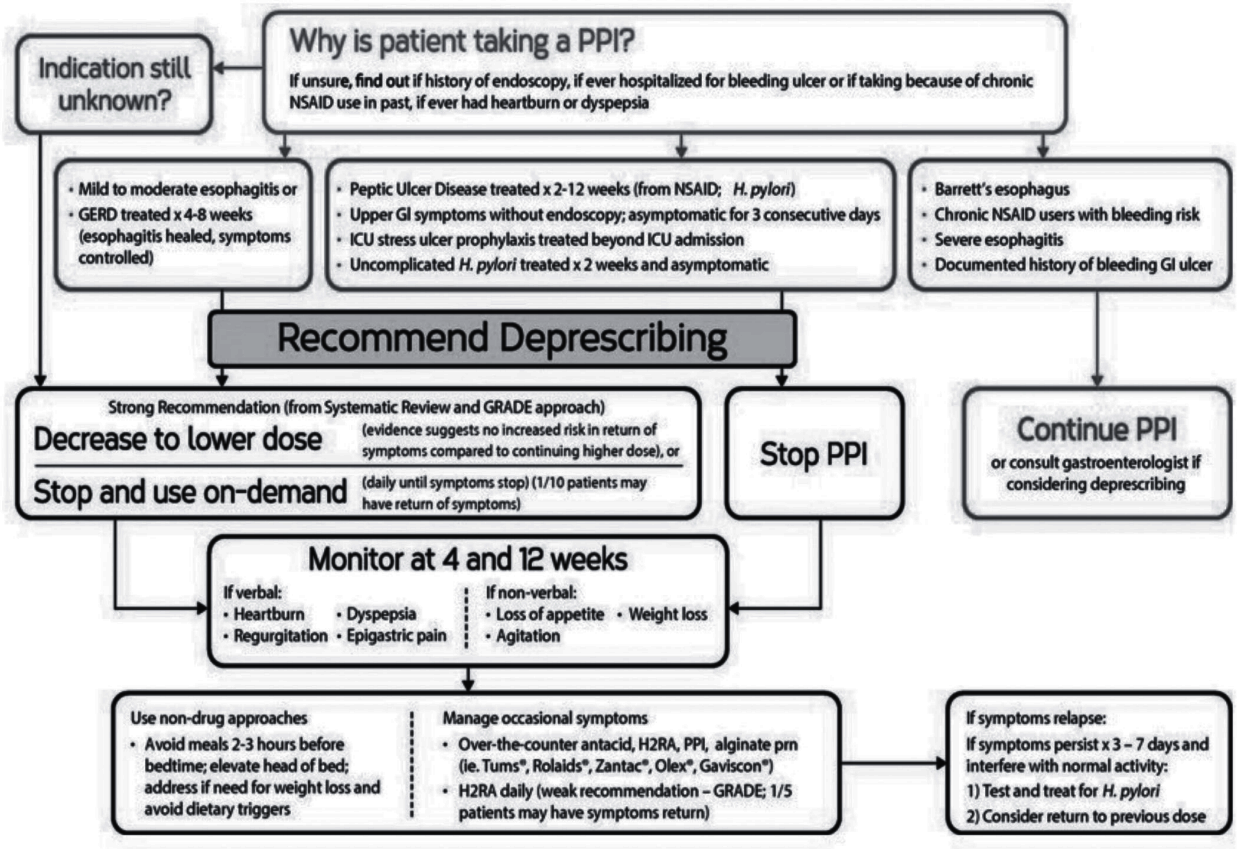
15 ☐ Intervention not done for new Rx
Reason ☐ No therapeutic issue
☐ Too busy
☐ Cannot contact any
☐ Step down of PPI already don
☐ Others _____

Recommendation accepted?
☐ Yes
☐ No

(Pharmacist signature)
Date:

Appendix 3

Algorithm of Deprescribing



IMPROVING THE PERCENTAGE OF DIABETES MELLITUS PATIENTS ON INSULIN WITH A GOOD UNDERSTANDING AND PRACTICE OF INSULIN INJECTION TECHNIQUES IN THE OUTPATIENT PHARMACY OF TELUK INTAN HOSPITAL

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Abstract

Poor understanding of insulin injection techniques contributes to poor glucose control and disease risk. The objective of this study was to improve the percentage of diabetes mellitus patients on insulin with a good understanding and practice of insulin injection techniques in the Outpatient Pharmacy of Teluk Intan Hospital. A quality improvement cohort study was conducted from January 2017 to June 2019. The result showed that only 5.1% (n=7) of the 137 recruited patients had a good understanding and practice of insulin injection techniques in the pre-remedial phase. Through the face-to-face interview and live demonstration conducted, the contributing factors identified were language barriers (48%), absence from counselling sessions (24%) and showing up during peak hours for the counselling session (15%). The incorrect practice of insulin injection techniques like improper disposal of used needles (92.4%), leaving used needles attached to insulin pens (89.8%) and incorrect priming of insulin pens (81.9%) were commonly observed. During the first interventional cycle, the workflow of insulin injection counselling was improved, pharmacists' training was enhanced and multilingual counselling sessions aided with audio-visual tools and live demonstrations were provided. In the second cycle, patients were given pictorial pamphlets, injection site rotation charts and containers for storage and disposal of used needles. The percentage of patients with a good understanding and practice of insulin injection techniques improved from 5.1% to 72.3% and 88.3%. During the sustainability phase (March 2018 to June 2019), the percentage decreased to 73.7% at two-year post-remedial due to skipping steps for convenience (65%), change of caretakers (21%) and poor memory (14%). Upon re-education, the percentage improved to 83.5% in May 2019. In conclusion, counselling delivery language and technique, live demonstration, effective counselling aids and re-education by trained pharmacists are essential in improving understanding and practice of insulin injection techniques among diabetic patients.

KEYWORDS: Insulin injection technique, Diabetes mellitus, Insulin counselling

Problem

Teluk Intan Hospital (HTI) is a specialised district hospital in Malaysia that covers Hilir Perak, Sabak Bernam, Batang Padang, Selatan Manjung and Perak Tengah. It also acts as a referral hospital for Tengku Ampuan Jemaah Hospital, Tapah Hospital, Slim River Hospital and part of Manjung Hospital and Changkat Melintang Hospital. The Outpatient Pharmacy of HTI caters to about 6,000 diabetes mellitus patients from the primary care and General Medicine Specialist Clinic for their monthly medical supply. Insulin users comprise about 10% of the total number of diabetes mellitus patients. Most of them are between the ages of 40 to 60, speak only their mother tongue and have long-standing diabetes mellitus.

A study conducted in the Outpatient Pharmacy at HTI in January 2017 showed that among all diabetes mellitus patients on insulin, 94.9% of them did not have the correct understanding and practice of insulin injection techniques. The incorrect techniques identified included injecting the wrong insulin dose, wrong timing or method of insulin injection, lacking priming and mixing, improper storage of insulin cartridges and insulin pens and improper storage or disposal of insulin needles. Lacking good understanding and practice of insulin injection techniques would result in uncontrolled sugar levels due to the wrong insulin dosage injected, which can increase the risk of target organ damage and complications of the heart, kidney, eyes, blood vessels and nerves and subsequently increase the rate of hospital admissions. In other words, improving patients' understanding of insulin injection techniques will help them control their blood sugar levels, reduce injection-related complications, reduce complications caused by uncontrolled diabetes and subsequently reduce hospital admission rates.

This study aimed to improve the percentage of diabetes mellitus patients on insulin with a good understanding and practice of insulin injection techniques from 5.1% to 80% within three months.

Background

Type 2 diabetes mellitus (T2DM) is a progressive disease characterised by worsening glycaemia due to a progressive decline in beta cell function (1). Continuous deterioration of beta cell function will ultimately render oral glucose-lowering drugs ineffective, hence, the reason why most patients with T2DM will require insulin therapy (2). The addition of insulin therapy is customary when glycaemic control is suboptimal (3). Insulin therapy is suitable at all stages of T2DM for all ages and comes with a wide range of treatment options and regimes (2). It can be initiated safely in outpatient settings and has the advantage of lowering glucose in a dose-dependent manner to almost any glycaemic target. Insulin pens are convenient, safe to use and accurate in dose delivery when used correctly (2). However, poor understanding and practice of insulin injection techniques are common among diabetic patients, and they can impede the patients from achieving their targeted haemoglobin A1C (HbA1c) level.

Based on the literature, poor understanding and practice of insulin injection techniques are common among diabetes mellitus patients worldwide. A study conducted in Turkey reported that 79.5% of the 200 participants were using expired insulin pens or cartridges, 70.5% did not rotate the injection site and 63% massaged the injection site after insulin injection (4). Also, a research carried out by the Outpatient Pharmacy of Batu Pahat Hospital showed that 90% of patients had poor knowledge and practice of insulin injection techniques and required re-education by pharmacists (5). A multi-centre study in Belgium among 4352 diabetic patients reported that 21% of the diabetes mellitus patients admitted injecting insulin on the same site over the entire day for a few days (6).

Patients who do not perform insulin injection techniques correctly have been shown to have a higher prevalence of insulin-related complications and hospitalisation rates (7). The study of Gentile et al. (8) showed a linear relationship between HbA1c levels and

the number of errors during insulin injection among T2DM patients, i.e., more errors during insulin injection would result in higher HbA1c values. Aside from a higher HbA1c level, improper insulin injection techniques may also cause other complications like lipodystrophy, bleeding and bruising at the injection site (9), as well as both severe and transient hypo- or hyperglycaemia, wide glycaemic excursions and diabetic ketoacidosis (10). Based on the 2007 - 2011 United States national surveillance data, Geller et al. (11) reported that insulin-related hypoglycaemia was the cause of an estimated 97,648 emergency department visits annually, with almost one-third of the visits ending up as hospital admission. Severe neurologic sequelae occurred in 60.6% of these visits, and blood glucose levels of less than 50mg/dL were documented in 53.4% of the cases (11).

Insulin injection errors may occur in any of the steps of the medication use process, including prescribing, transcribing, dispensing and administration steps, even though most of the errors were observed during administration (7). A study conducted in the United States showed that lacking education on operating an insulin pen is one of the common reasons for improper insulin injection (7). Regarding this matter, a global survey done by Frid et al. (12) showed that fewer than 40% of patients on insulin worldwide received proper counselling in the last six months, and 10% of the patients said that they had never received training on how to inject insulin correctly despite injecting for a mean of nearly nine years.

Truong et al. (7) have reinforced the need for repeated insulin education and continual assessment of insulin administration. Patient counselling on proper insulin injection techniques is essential to ensure they receive the prescribed insulin dose and prevent injection-related complications due to improper injection (13). Also, a teach-back method is an approach that can be used to assess patients' techniques and re-educate them at every available opportunity to reduce the risk of administration errors (7). Patients are also more likely to rotate injection sites correctly if they received injection instructions from their healthcare provider in the past six months. Moreover, community pharmacist-led educational interventions in multidisciplinary group sessions on self-care for diabetic patients have also been proven to have long-lasting benefits on glycaemic control (14). Besides that, the findings from another study conducted on 87 patients on insulin showed improvement in glycaemic control after re-education of insulin injection techniques based on the result of HbA1c, especially in those with a poor understanding of insulin injection techniques (15).

Measurement

The indicator of this study was the percentage of diabetes mellitus patients on insulin with a good understanding and practice of insulin injection techniques in the Outpatient Pharmacy of HTI with a standard of at least 80%. The percentage was calculated using the formula below:

$$\textit{Percentage of diabetes mellitus patients on insulin with good understanding and practice of insulin injection techniques} = \frac{\textit{Number of diabetes mellitus patients on insulin with good understanding and practice of insulin injection techniques}}{\textit{Total number of diabetes mellitus patients on insulin who are recruited for insulin injection technique reassessment and counselling}} \times 100\%$$

A questionnaire to measure patients' understanding of insulin injection techniques was developed based on the 5-steps of Correct Use of Medicine (16), the Step-by-Step Counselling Guideline Checklist by the Pharmaceutical Services Division, Ministry of Health Malaysia (17), and also updates and recommendations from the Forum for Injection Technique Malaysia (FIT-MY) (18).

The developed questionnaire consisted of 3 parts, with a total of 34 questions. The first part of the questionnaire included three questions on demography: age, race and gender. The second part of the questionnaire explored specifically patients' correct use of the prescribed insulin regimen, such as the

type of insulin, the type of insulin pen, the dose of insulin injection, the frequency of the insulin regime, the timing of insulin administration and the rotation pattern of the injection sites. The third part of the questionnaire consisted of a simplified checklist of 28 items to assess patients' practice through injection technique demonstration, which was based on the combined step-by-step counselling guideline and recommendations by the FIT-MY. A higher weightage was given to critical steps that determined the correct understanding, such as correct priming, dialling and injection site rotation, considering the importance of the steps in the treatment. Each question in Parts 2 and 3 carried 1 point if answered correctly, with a maximum score of 28 points per patient. Patients who scored a minimum of 23 points out of 28 points or 80% passing mark were considered to have a good understanding and practice of insulin injection techniques.

A pre-remedial study was conducted from January to February 2017 to verify the existence of poor understanding and practice of insulin injection techniques in diabetes mellitus patients on insulin in the Outpatient Pharmacy of HTI, as well as to identify the contributing factors with a questionnaire survey. All adult diabetes mellitus patients on insulin who visited the Outpatient Pharmacy of HTI between January and February 2017 were scheduled for an appointment to assess their insulin injection techniques. Patients who turned up for the appointment were recruited into this study until the required sample size was achieved, which was a minimum of 137 samples. The inclusion criterion for this study was all adult type 1 or type 2 diabetes mellitus patients who were using insulin pen injections. The primary caretaker who helped with insulin injecting were assessed if the patient was not self-injecting. Patients using insulin syringes, inpatients with cognitive dysfunction or psychiatric patients and absentees were excluded from this study. The questionnaire was administered in a face-to-face interview, which included patients' demonstration of insulin injection techniques. During the interview session, patients were also asked about the reason for their poor understanding and practice of insulin injection techniques. The pre-remedial study showed that only 5.1% of the patients had a good understanding and practice of insulin injection techniques. It was also noted that the hospital recorded 203 admissions due to hypoglycaemia from January until December 2016.

Remedial measures were implemented from March to June 2017 in two cycles: the first cycle was from March to April 2017, and the second cycle was from May to June 2017. The same patients were evaluated before and after the intervention to measure the effectiveness of the remedial measures. The post-remedial evaluation was conducted in the subsequent month after implementing the remedial measures. Patients who scored less than 80% in the assessment on their understanding and practice of insulin injection techniques during the first cycle were required to undergo the second cycle with enhanced remedial measures to ensure they could achieve the target standard.

The measurement was continued in subsequent years to determine the sustainability of the intervention. The first sustainability cycle was from March to April 2018, and the second cycle was from April to May 2019, with reinforcement of remedial measures. The reinforced remedial measures were re-evaluated between May and June 2019 to re-evaluate the effectiveness of the remedial measures implemented. The same methodology was used for the assessment during the sustainability cycle.

Initial Assessment of the Problem

The initial process of care for insulin counselling for diabetes patients is shown in Figure 1. Before this study, patients who were newly started on insulin therapy had to obtain their insulin pen supply and counselling from the Diabetes Education Centre located in another building before heading to the Outpatient Pharmacy for the supply of insulin cartridges and medications. It was observed that patients with mobility difficulties, time constraints and poor sense of direction would often omit going to the centre and directly proceed to the pharmacy for their medications, only to be asked to return to the centre for their insulin pen supply.

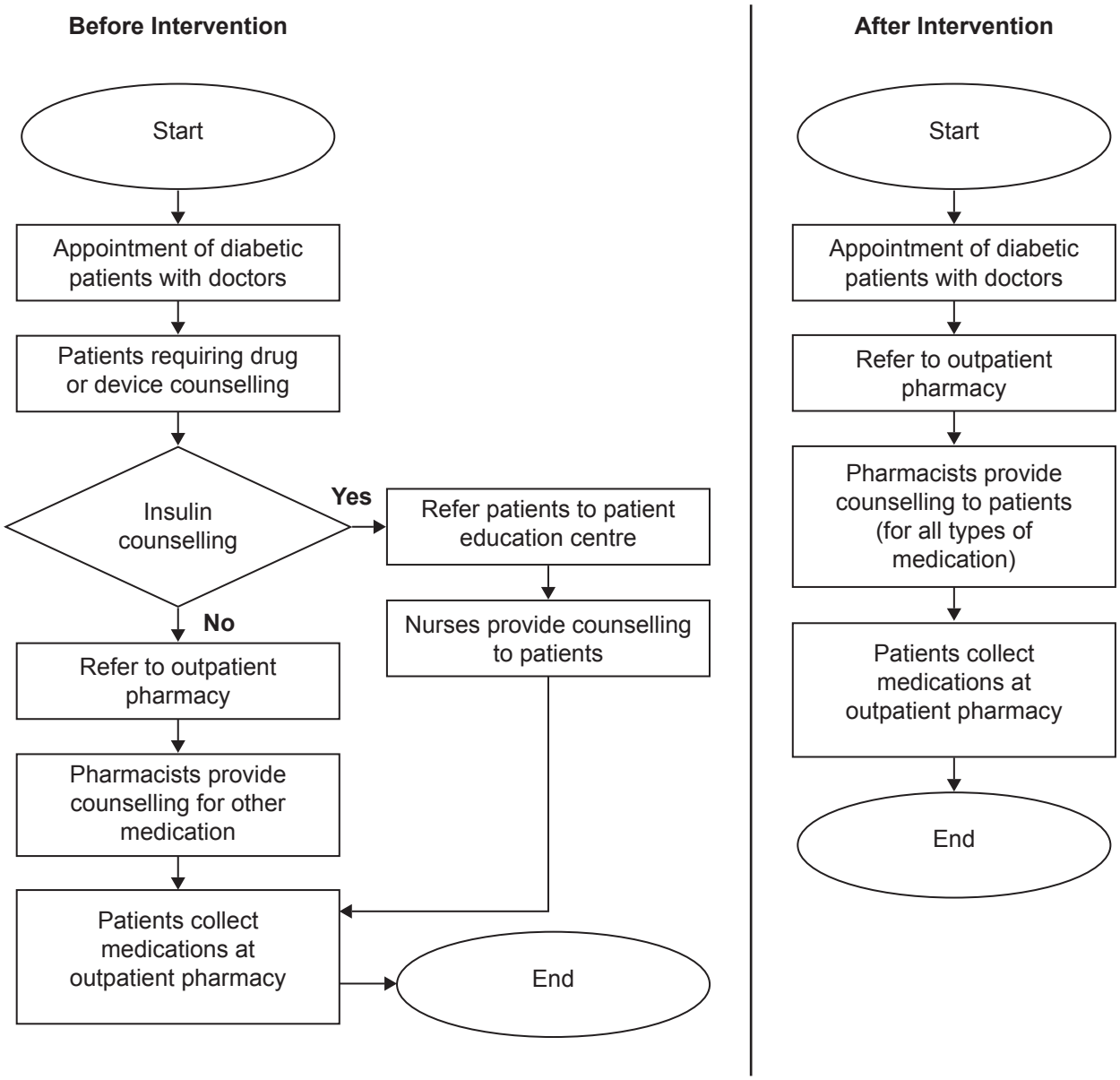

Figure 1: Process of care for insulin counselling before and after intervention

It was also noticed that there was only one diabetes educator available at the Diabetes Education Centre, who was required to handle an array of tasks, including supplying new insulin pens to patients, counselling patients who were newly started on insulin, counselling ward-discharged diabetes patients, providing foot care, educating patients on the use of glucometer device and self-monitoring blood glucose counselling, as well as selling insulin needles and glucometers on behalf of the Teluk Intan Branch of Malaysian Diabetes Society. During peak hours, the quality of the insulin pen counselling was often compromised due to time constraints; the service was sometimes interrupted because the diabetes educator was unavailable.

Moreover, replacement insulin pens and cartridges were supplied to patients during a shortage of insulin pens or insulin cartridges, which occasionally resulted in a mismatch of insulin pen and cartridge as the pen and cartridge were supplied from two different locations. Mismatched insulin pens and cartridges can compromise the fixing of the insulin pens and the accuracy of insulin delivery. Hence, the insulin pen and cartridge mismatching issue were also included in this study for remediation.

Initial assessment of patients' correct use of the prescribed insulin regimen

discovered poor understanding in two main areas: the timing of administration of insulin injection (38.8%) and the rotation pattern of injection sites (21.4%). On the other hand, correct insulin dose (63.3%) and correct frequency of insulin injection (57.1%) scored fairly.

Initial assessment of the patients' demonstration of insulin injection techniques based on the checklist of 28 items revealed below the satisfactory score for the priming of insulin pen (18.1%), dialling of insulin dose (48.3%), reusing of insulin needles (35.3%), leaving the needle attached to the insulin pen (10.2%) and correct disposal of insulin needles (7.6%). Meanwhile, patients scored fairly in the techniques of assembly of insulin cartridge and pen (63.7%), preparation of insulin (58.9%), fixing the insulin needles (58.9%), injection of insulin at 90 degrees angle (68.2%), storage of insulin (69.1%) and storage of insulin pen (62%).

A total of 142 diabetes mellitus patients were recruited for this study. Five patients were excluded as they were unable to attend the re-evaluation session. The results showed that 94.9% (n=130) of the insulin users did not have a good understanding and practice of insulin injection techniques. In other words, only 5.1% (n=7) of the insulin users demonstrated a good understanding and practice of insulin injection techniques during the assessment.

The identified main contributing factors to the low percentage of insulin users with correct understanding and practice of insulin injection techniques were the language barrier between the counselling provider and the recipient (48%), patients absent from counselling sessions (24%), patients attending counselling sessions during peak hours (15%), patients rejecting counselling sessions (8%), no brochure (4%) and no leaflet in multiple languages (1%).

Strategy

In the first cycle of the remedial phase, the issues of heavy workload and time constraints of the diabetes educator were addressed by revising the process of care for insulin counselling (refer to Figure 1). The new process of care allowed outpatient patients who needed insulin injection counselling to be directly referred to the Counselling Unit of the Outpatient Pharmacy. The change in the workflow enabled the patients to receive counselling and medical supply at the same location simultaneously and hence, saved time and reduced the chances of patients not attending the counselling session.

A training workshop on insulin injection techniques by the Perak State Diabetes Mellitus Medication Therapy Adherence Clinic (DMTAC) preceptor was organised to evaluate, train and re-evaluate insulin injection techniques among pharmacists involved in insulin injection counselling. All outpatient pharmacists were required to attend the training workshop to ensure the information delivered to patients was aligned and complete. The technique for delivery of counselling was also taught in the workshop to ensure that the counselling given was effective.

Remedial measures targeting the main contributing factor to poor understanding and practice of insulin injection techniques, i.e., language barrier, were also developed and implemented in the first cycle of the remedial phase. The insulin injection counselling was prepared in four different languages: Malay, English, Mandarin and Tamil. The counselling sessions in different languages were held daily from Monday to Thursday every week at 9.00 am, 11.00 am, 2.30 pm and 3.45 pm. A schedule with date, time and officer on duty was released at the beginning of each month for patients or primary caretakers to plan and register for a counselling session based on their preferred date, time and language. Every counselling session was limited to a maximum of eight patients. Reminder messages were sent upon patients' registration to remind them of the date, time and equipment required on the counselling day. Patients who were absent on the registered counselling day were contacted via phone calls, and they were rescheduled to a new date and time if they could not attend the session.

The counselling sessions were also enhanced with audio-visual aids and hands-

on practices. During the counselling session, short videos on each step of insulin injection were played to the patients, followed by a live demonstration and explanation by a pharmacist on the steps and a step-by-step practical session for the patients. At the end of the session, patients were required to re-demonstrate the whole insulin injection process to the pharmacist so that mistakes and confusion were addressed and corrected on the spot. Patients who required extra guidance were counselled individually.

In the second cycle of the remedial phase, patients were re-counselled on specific insulin injection techniques that they could not perform correctly. Pictorial brochures and infographics were given to patients as a reminder to strengthen their understanding and memory of what they were taught and counselled. Supporting tools such as a rotation chart for injection sites and containers to store and discard used needles were also provided to patients to encourage correct practice and hygiene of insulin injection.

Revision counselling was implemented between April and May 2019 as a decline was noticed in the percentage of patients with a good understanding and practice of insulin injection techniques two years after the patients underwent their first counselling session in 2017. During the revision counselling session, their weak points were identified, and the patients were re-educated on the correct insulin injection techniques.

Results

After the first cycle of remedial actions, the percentage of diabetes mellitus patients on insulin with a good understanding and practice of insulin injection techniques increased from 5.1% (n=7) to 72.3% (n=99). Patients' adherence to the timing of administration of insulin injection improved to 82.4%, the rotation pattern of injection sites improved to 52.6%, the correct dose of insulin improved to 89.8% and the frequency of insulin injection improved to 87.3%. Also, increments in the percentages of patients with correct practices of insulin injection techniques were observed, i.e., priming insulin pen (72.4%), dialling insulin dose (92.3%), changing insulin needles (66.7%), leaving the needle attached to the insulin pen (63.2%), disposal of insulin needles (55.9%), assembly of insulin cartridge and pen (89.7%), preparation of insulin (89.7%), fixing the insulin needles (92.6%), injection of insulin at 90 degrees angle (88.2%), storage of insulin (92.4%) and storage of in-use insulin pen (81.8%).

For the remaining 27.7% (n=38) of the patients who still could not master the correct insulin injection techniques after the first cycle of remedial actions, the reasons identified included having difficulty in visualising the injection site rotation (47.4%, n=18), lack storage and disposal containers for used needles (36.8%, n=14) and weak memory (15.8%, n=6). Hence, the counselling strategies were reinforced and enhanced in the second cycle of the remedial phase, with new remedial measures implemented on top of the existing remedial measures implemented in the first cycle.

After the second cycle of remedial measures, the percentage of insulin users with a good understanding and practice of insulin injection techniques increased to 88.3% (n=121), surpassing the target of 80%. For the patients who did not achieve the 80% passing mark of the assessment in the second cycle, improvement was still observed in their overall understanding of insulin injection techniques as compared to their achievement in the first cycle. In the sustainability phase one year later, 81.1% of the insulin users maintained a good understanding and practice of insulin injection techniques. Also, the number of admissions to the hospital due to hypoglycaemia dropped to 160 from January to December 2017.

However, the percentage of patients with a good understanding and practice of insulin injection techniques dropped to 73.7% two years post-remedial study. Further exploration of the reasons for the percentage drop revealed three contributing factors, i.e., skipping steps for convenience (65%), change of caretakers (21%) and poor memory (14%). Patients who did not achieve the 80% passing mark in the sustainability assessment were re-educated on the correct insulin injection techniques and re-evaluated after one month.

The percentage of insulin users with a good understanding and practice of insulin injection techniques increased to 83.5% in May 2019.

The achievable benefit not achieved (ABNA) results for the pre-remedial phase, the first and second cycles in the remedial phase, and the three cycles in the sustainability phase are shown in Figure 2.

Lessons and Limitations

The ability of healthcare professionals to provide sufficient and complete education to patients is pivotal to ensure patients are equipped with a good understanding and the right techniques to perform insulin injections at home. It was evident from this study that counselling and re-education are essential to improve patients' insulin injection techniques.

The main challenge of this study was patients' attendance at the scheduled counselling sessions, assessments and re-evaluations. All efforts to remind patients to attend the sessions are crucial to ensure they make time to have an effective counselling session provided by the team. Besides, arranging the schedule of counselling sessions was another challenge faced in this study, as the availability of specified pharmacists with respective language specialty and fixed counselling schedules needed to be considered simultaneously.

The limitation of this study was that only patients from the Outpatient Pharmacy were recruited into the study, while patients from other settings, such as inpatients, were omitted.

Conclusion and the Next Steps

This study found that language, counselling techniques, live demonstrations and teaching aids are essential in providing a good foundation for good understanding and practice of insulin injection techniques among diabetes patients. Continuous training for pharmacists and paramedics who provide insulin injection counselling is also essential

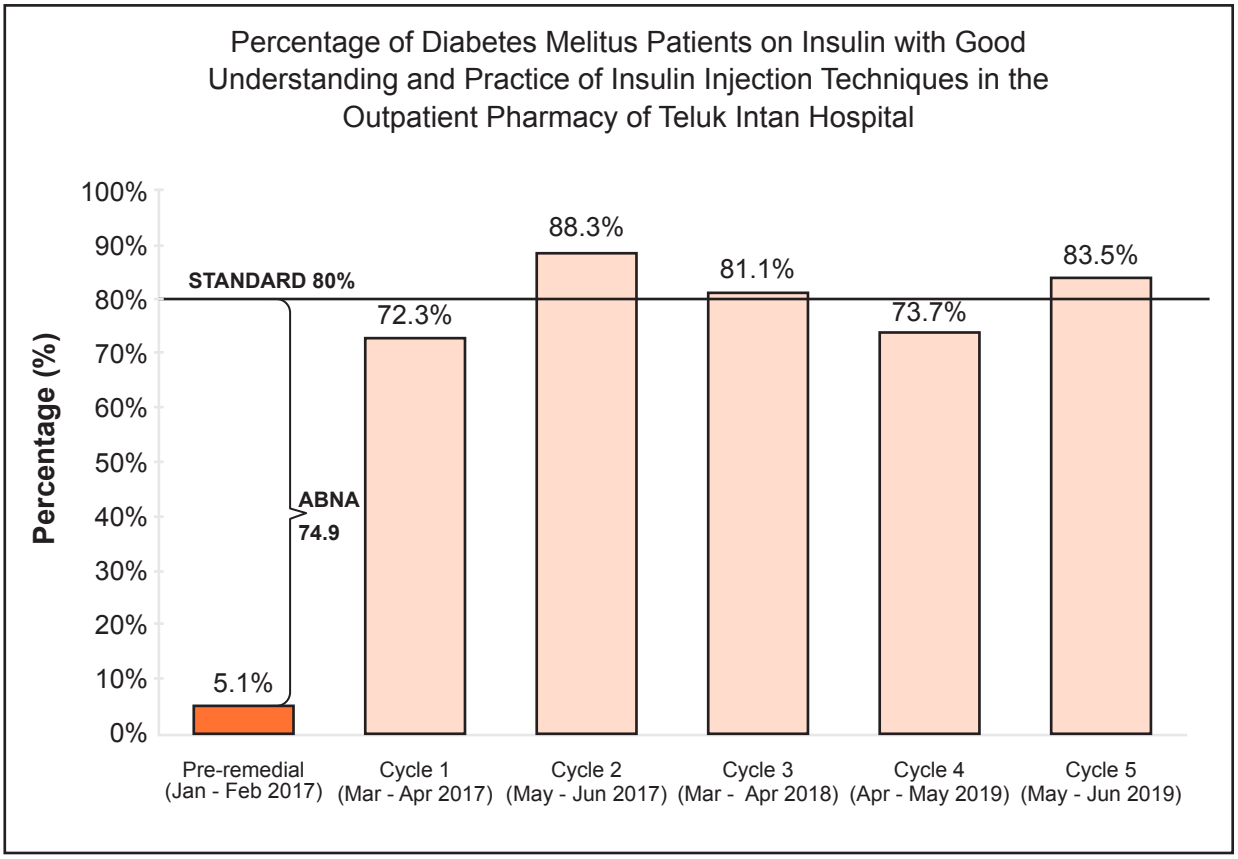

Figure 2: Achievement of Percentage of Diabetes Mellitus Patients on Insulin with Good Understanding and Practice of Insulin Injection Techniques Pre and Post Remedial Phases

to ensure updated, standardised information is delivered to patients. Also, the counselling skills of pharmacists should be enhanced to boost the effectiveness of each counselling session.

Reassessing patients' insulin injection techniques every two years is critical in sustaining a good understanding and practice of insulin injection techniques in patients on insulin. Besides, a yearly assessment will allow early detection of a decline in the understanding of insulin injection techniques so that remedial actions can be taken to maintain a good understanding level. If a decline is detected, patients should be re-educated through revision counselling to refresh their memory on the correct insulin injection techniques. Empowerment of caregivers through education and training should also be emphasised for patients with memory impairment.

To overcome the limitation of human resources in providing insulin injection counselling in four different languages, a QR code system was developed to direct patients to pre-recorded videos on insulin injection technique demonstrations for teaching, revision and assessment purposes. Furthermore, the videos have been made available to inpatient patients and widened to include other types of counselling. The QR code link and re-education system have now been applied to inhalers.

Once patients can sustain their good understanding and practice of insulin injection techniques for an extended time, the authors will explore the impact of having a good understanding and practice of insulin injection techniques on patients' glycaemic control. In future studies, the percentage standard for patients with a good understanding and practice of insulin injection techniques can be further increased, and additional indicators of fasting blood sugar and HbA1c can be added. The impact of having an improved understanding of insulin injection techniques on blood sugar control can be explored as well.

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Conflict of Interest

The authors declare that there was no conflict of interest.

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

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

Your manuscript should include:

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

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

Initial Assessment of the Problem	Describe what processes are involved in your problem including the critical that will contribute to the achievement of your final goal. Describe on the perceived factors that could contribute to the problem and how you quantify them. Include here the results of the study that you conducted to identify the contributing factors to the problem.
Strategy	In this section you should explain your strategy for improvement to the reader and discuss how you implemented your improvement cycles. In most cases you will have tried a number of progressive improvement cycles, some of which will not have been successful. It is important that you also share these to help others avoid similar difficulties. Remember that data should be collected continuously throughout your project. This is a difficult section to document and will contain a lot of information. For each PDSA cycle you should describe your aim, your change hypothesis and strategy for change. a) Describe how you implemented the change and the data you collected. b) Describe your key learning from each cycle of change, and discuss how this learning impacted on your change process. c) How well did your predictions of what change was needed match your outcomes? d) What worked more effectively than anticipated and what had less effect than predicted?
Results	Provide a summary of your results using appropriate chart or diagram. a) Describe the variation in your data. b) Were the interventions you made responsible for any improvements? c) Describe how contextual elements interacted with the intervention(s) and affected your results. d) Compare your results to your baseline measurement. Comment on how you assessed whether the data was complete and accurate-was there any missing data? Please comment on whether there were any unintended consequences such as unexpected benefits, problems, failures or costs associated with the intervention(s).
Lessons and Limitations	In this section, discuss the lessons you learnt from the project and its limitations. Comment on the strengths of the project. Describe any problems you faced and how you navigated these. If you were to undertake this project again, what would you do differently? Reflect on your project's limitations. For example, did you realise as the project was implemented that your results would be affected by unforeseen factors such as a small sample size or the turnaround of patients or staff? Comment on the limits of generalisability. Describe whether chance, bias, or confounding have affected your results and whether there was any imprecision in the design or analysis of the project. Are more data points required? Were efforts made to minimize/adjust for any limitations? Although we accept publications using different improvement approaches, we would expect you to have modified your intervention as it was implemented and undergone a process of continuous improvement, measurement and learning. If your project does not fit with this approach then we would like to see reflections and learning here about how you could have incorporated continuous improvement and measurement approaches in your project.

Conclusion and the Next Steps	You should reflect on your background research, noting what is already known on this topic and what your project adds. You should refer back to your aims statement – did your project achieve its aims? Did you adjust your aims as you went along? Was it a useful project? Were your measures appropriate and did you use balancing measures? Think about what your senior sponsor would like to see as an output of your work and what can help others to make the case for undertaking a similar piece of work – or for doing something differently if your project was not successful. Please describe your cost analysis here, were there any financial savings that your project made? Being able to demonstrate that your intervention delivered savings really helps to add value. Give an assessment of whether you think your project is sustainable – do you have enough data? What have you done to try to ensure that your work continues? Comment on how you would spread your project and whether it could be replicated elsewhere. Discuss what your next steps will be and whether further study in the field is required. The point of the conclusion is not to rewrite the whole project, but to give an overview of how the whole project was conducted, what it achieved, and some personal reflections.
References	In this section you should record any references to published material that you refer to elsewhere in your project. This is particularly likely to include material from background reading or from your conclusions. Use the Vancouver style for referencing.
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