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IMPROVEMENT OF THE HEALTHCARE SERVICE SYSTEM: THE UPPER NORTHERN HOSPITAL NETWORK OF THAILAND

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Cleft lip and/or cleft palate are the most common craniofacial congenital disability, with an estimated 2 affected babies born per thousand in Thailand. Chiang Mai University Craniofacial (CMU CF) center plays a role as the one-stop service providing this type of healthcare. This center serves as the coordinator between hospitals in the treatment network and patients. This research aims to reduce the delays throughout the patients' treatment plan of the case study hospital as one of the hospitals in this network. Starting with problem identification, two treatment steps, including hearing testing (ABR/OAE) and Cheiloplasty, were 80% of the total delay from the data collection. Then, Root-cause analysis was conducted by interviewing specialists and studying patients' documents. The main cause of delays was that the patients needed to be transferred from rural hospitals in the area to the hospital that is the subject of our case study. The supporting operations that help in serving patients need co-working operations between the case study hospital and the CMU CF center. Supporting operations including 4 parts were studied and improved based on the Lean concept. Standard procedures were set up when non-value-added activities were eliminated, and value-added activities were improved by IT solution implementation. Finally, when the supporting operations were performed via an IT solution, the processing time can be reduced. Moreover, the implementation of an IT solution helps in tracking and monitoring patients' status – this advantage leads to a reduction in the number of delayed patients and a reduced delay time in the treatment plan.

Keywords: eHealth, protocols and information communication, procedures for process planning, collaborative networked organizations principles

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1. INTRODUCTION

The treatment of cleft lip and cleft palate includes continuous follow-up treatment and that requires the coordination of treatment by a multidisciplinary team of pediatricians, plastic surgeons, dentists, and speech therapists. Patients have to visit many specialists throughout their treatment plan from the time they are born until the treatments are completed at about 20 years old. Treatment is not only long-term but also interrelated, as each treatment step has an effect on the succeeding steps in terms of treatment effectiveness. Delays throughout the treatment plan are common and extend treatment time. Similar to production management, healthcare operations management considers two flows of patients and information. The flow of information usually leads the flow of patients. Thus, the information flow along the treatment plan is critical when treatment time and results need to be optimized.

The Chiang Mai University Craniofacial (CMU CF) Center, at Chiang Mai University provides the information system solution, namely the Thai Cleft Link (TCL) system, which facilitates patients' treatment so that it is on-time and following the treatment protocol that increases the effectiveness of the treatment. Currently, the data of patients who first visit the university's hospital can be recorded directly to TCL. The treatment plan of each patient can be monitored and managed by the staff of the center, which ensures on-time treatment and tracking the patients' status along the treatment plan. However, the role of this center is not only to care for patients of the university's hospital, the center is also responsible for patients from 9 provinces from the northern region of Thailand.

The case study hospital is a provincial hospital in Chiang Mai province, Thailand. This hospital also provides care to patients with cleft lip and/or cleft palate and is part of the network for cleft lip and/or cleft palate treatment. Unfortunately, the TCL system is not available for other members (hospitals) in this network due to the unique workflows of each hospital. We picked this hospital for our case study to analyze how the patients are served and what problems occur along the treatment plans in order to identify the points for improvement.

When considering patients with cleft lip and/or cleft palate at the case study hospital, the first objective of this study is to identify problems along the treatment plan. The second objective is to analyze and improve the workflow of serving patients using the Lean concept.

Finally, improvements to be implemented by the hospital are proposed which can help increase the quality of the treatment and therefore improve the quality of life for patients.

2. CASE STUDY

2.1. The Upper Northern Hospital Network of Thailand

The Chiang Mai University Craniofacial Center or CMU CF center is the treatment center at the hospital under Chiang Mai University established in 2011 by combining plastic surgery, neurosurgery, otolaryngologists, ophthalmologists, anesthesiologists, orthodontists, and nurses to establish a multidisciplinary team for the treatment of patients with cleft lip and/or cleft palate. This center plays a role in providing treatment for cleft lip and/or cleft palate patients from the womb until adulthood to allow the patient to have a good quality of life at any age until normally living and working with other people (Suwiwattana et al., 2020). Patients from 9 provinces of the northern part of Thailand were supported in terms of organizing treatments by this center and networking hospitals. CMU CF center implemented a Thai Cleft Link or TCL information system for collecting patient data and providing important operations that are related to patients' treatment, for example, registration, recording treatment data, and the transfer of patients. Thus, the data of patients who first visit the hospital under the university are stored and can be easily analyzed and scheduled to follow the treatment plan. However, in other networking hospitals it is difficult to implement the same procedure due to some limitations in terms of unique operations/procedures at each hospital.

Patients with cleft lip and/or cleft palate are classified into 3 groups: cleft lip, cleft palate, and cleft lip together with cleft palate. The treatment plans for cleft lip and/or cleft palate patients depend on the nature of the disorder and the doctor's diagnosis. Patient data was collected including date of birth, age, gender, address, disorder type, and treatment date to determine the cause of delay in the treatment protocol. The treatment guidelines for cleft lip and/or cleft palate are presented in table 1.

Addressed earlier in Mossey et al. (2009), table 1 presented the general treatment guidelines for cleft lip and/or cleft palate summarizing the complications occurring along the treatment protocol from the time the patient is a newborn until the face is fully grown (about 18 to 20 years). The treatment protocol of the cleft lip and/or cleft palate is an interdisciplinary cooperation, thus the treatment result of each stage is also affected by others. Moreover, treatment protocols for each group of patients are different (presented as table 2).

Table 1. Treatment guidelines for cleft lip and/or cleft palate

Age	Nurse	Pediatrician	ENT	Orthodontics	Plastic surgery& Maxillofacial surgery	Prosthodontics	Speech therapist
Prenatal	Counselling and Coordinator						
0-1 months		General evaluation (genetic test when indicated)	Micrognathia evaluation	Nasoalveolar molding and/or Palatal obturator			
1-3 months		Neurologist / cardiologist/ growth and development (when indicated)	Hearing evaluation (OAE test)				
3-5 months					Cheiloplasty with Primary cleft lip nose correction	Post-operative day 7-14 Nasal adjustor	
5-9 months				Palatal obturator (Cleft palate)			
9-18 months			myringotomy with PE tube retention (when indicated)	Dental care	Palatoplasty or cheilopalatoplasty with primary cleft lip nose correction	Post-operative day 7-14 Nasal adjustor (when indicated)	
2-5 years							Speech therapy after palatoplasty
5-6 years			VPI evaluation By Fibcroptic nasopharyngoscope			Post-operative day 7-14 Nasal adjustor (when indicated)	Speech therapy When VPI indicated
6-7 years				Orthodontic treatment for alveolar bone grafting	VPI correction (when indicatcd)&2nd cleft lip nose correction with bone block to pyriform, cartilage rearrangement and sill reconstruction (when indicated)		Speech therapy after VPI correction
7-12 years					Alveolar bone grafting&2nd cleft lip nose correction with bone block to pyriform, cartilage rearrangement and sill reconstruction (when indicated)	Post-operative day 7-14 Nasal adjustor (when indicated)	
12-17 years				Orthodontic treatment for malocclusion and/or maxillary hypoplasia			
17-18 years					Jaw surgery		
>18 years					Final cleft lip nose correction by opened rhinoplasty approach	Post-operative day 7-14 Nasal adjustor	

Table 2. The treatment protocols for each group of patients

Symptoms	Treatment protocol	Duration of treatment
Cleft Lip	1. Nasoalveolar Molding: NAM	0-4 months
	2. Cleft lip repair: cheiloplasty	≤5 months
	3. Nasal Adjustor	≤5 months
	4. Follow-up 7-14 days after discharge	≤5 months
	5. Follow-up 1 month after discharge	≤6 months
	6. Follow-up 3 months after discharge	≤9 months
	7. Speech therapy	≤2 years
Cleft palate	1. Otitis media with effusion: OAE	0-4 months
	2. Cleft palate repair: palatoplasty	≤12 months
	3. Follow-up 7-14 days after discharge	≤12 months
	4. Follow-up 1 month after discharge	≤1 year 1 month
	5. Follow-up 3 months after discharge	≤1 year 2 months
	6. Speech therapy	≤2 years
Cleft lip and Cleft Palate	1. Nasoalveolar Molding: NAM	0-4 months
	2. Cleft lip repair: cheiloplasty	≤5 months
	3. Nasal Adjustor	≤5 months
	4. Follow-up 7-14 days after discharge	≤5 months
	5. Follow-up 1 month after discharge	≤6 months
	6. Follow-up 3 months after discharge	≤9 months
	7. Otitis media with effusion: OAE	≤6 months
	8. Cleft palate repair: palatoplasty	≤12 months
	9. Follow-up 7-14 days after discharge	≤12 months
	10. Follow-up 1 month after discharge	≤1 year 1 month
	11. Follow-up 3 months after discharge	≤1 year 2 months
	12. Speech therapy	≤2 years

Claire (2019) addressed that using a Pareto chart for presenting the frequency of defects can help in prioritizing problems and major defects can be solved with the greatest overall improvement. We applied the Pareto chart to present data of 234 patients including 54 cleft lip patients, 68 cleft palate patients, and 121 cleft lip and cleft palate patients. Comparing the patients' treatment record and treatment protocol, the major operations with delay were hearing evaluation (ABR/OAE) with 47.06% and cleft lip repair (Cheiloplasty) with 41.82% (fig. 1).

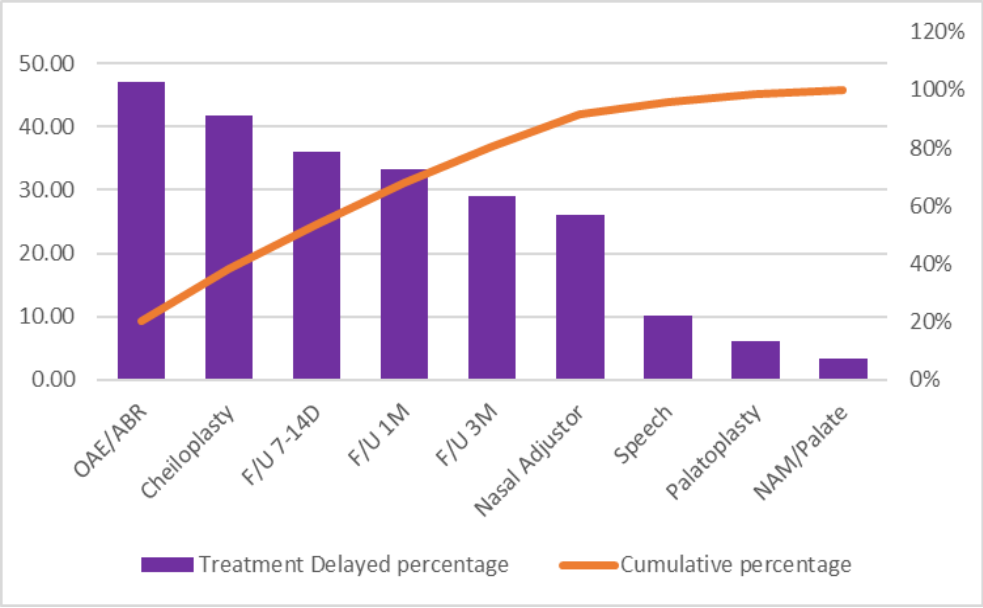

Fig. 1. The Pareto chart of operations with delay

3. METHODOLOGY AND RESULTS

3.1. Root-cause identification

As mentioned earlier, ABR/OAE and Cheiloplasty were the major operations causing delays. To identify the root causes, data collection of sample patients and interviews with specialists were conducted.

The sample data of patients who were admitted to the case study hospital aged 0-10 years without complications from Thai cleft link database were analyzed and presented in figure 2.

There were six causes of delay presented in figure 2. Three major causes were loss of follow-up, delay from the previous steps, and transferred patients. These three causes have an effect on one another. When patients were trans- ferred from the host hospital to the case study hospital, the transfer document was assigned to patients and they needed to visit the case study hospital with this document to continue their treatments. There is no tracking system to ensure that patients will receive the treatment on time as the appointment. Then, some patients lose follow-up and are absent at the appointment. From this investigation the conclusion is that when patients need to be transferred, a standard procedure or system should be proposed to ensure or facilitate patients' transfers and timely treatment.

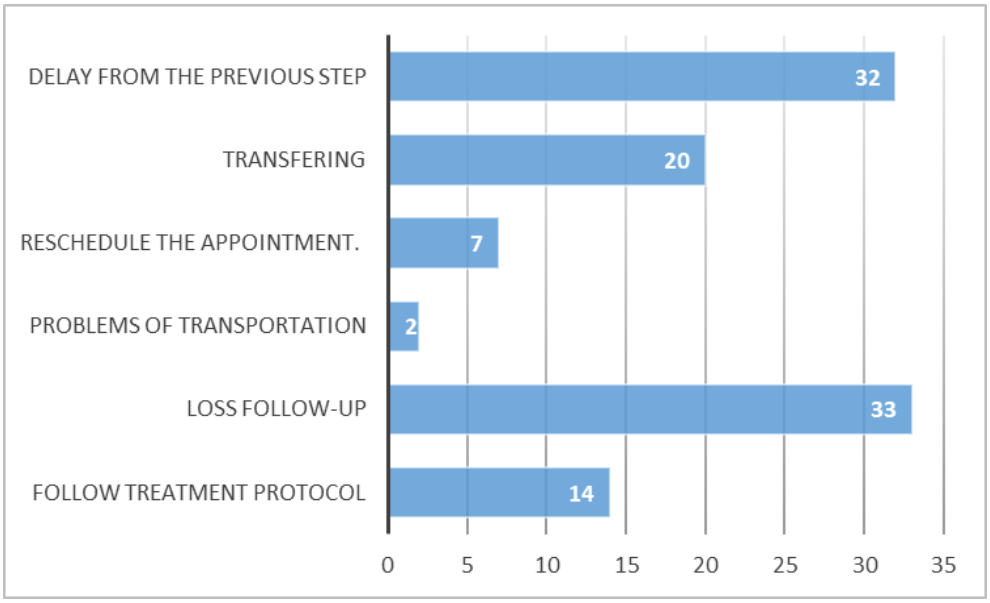

Fig. 2. Cause of delay in treatment protocol

In addition, the interviewed specialists stated that ABR/OAE is the treatment step that is the first visit for patients at 0-4 months. If patients delay the first visit, consequently, this step will be delayed. According to the previous study, Suwiwattana et al. (2020) mentioned that the delay during the treatment

protocol of cleft lip and/or cleft palate was affected by the delay in the first visit of patients. Especially, patients transferred from other hospitals (first contact not at the university's hospital) were faced with a delay in the treatment protocol because of the lack of standard procedures for patients' transfers.

The same situation occurs at the case study hospital. The case study hospital is a provincial hospital in Chiang Mai province. Other hospitals in the rural area of Chiang Mai can transfer patients with complicated symptoms to the case study hospital, including cleft lip and/or cleft palate. Standard procedures for patient transfers are also not systematic and that usually leads to loss of communication with transferred patients and delays.

As was the case with ABR/OAE, the same was true for cheiloplasty – the cause of delay was similar when patients were transferred from the host hospital to the case study hospital for this operation.

3.2. Supporting operations investigation

CMU CF center is a one-stop service for cleft lip and/or cleft palate patients who are residents within the northern region of Thailand. The main role of this center is to facilitate the coordination of treatment between patients and hospitals within the network. Supporting operations between CMU CF center and the case study hospital were studied. As addressed by Black and Miller (2008), the workflow was used to define specific steps and sequences, especially those processes that represent complex routine work, that involve many activities that engage many persons and that are in general frequently performed. The supporting operations between the CMU CF center and the case study hospital are divided into 4 parts and presented as workflows as follows:

- Outpatient department including consulting, treatment planning, transferring, making an appointment, medical recording, and reimbursing travel expenses (fig. 3).
- Surgical department including pre-operative checkup, cleft repairing, post-operative checkup, transferring, making an appointment, and follow-up (fig. 4).
- Speech training department including speech therapy, making an appointment, medical recording, and reimbursing travel expenses (fig. 5).
- Patient transfer procedure including making the transfer form, coordinating the patient's transfer, and confirming at the case study hospital (fig. 6).

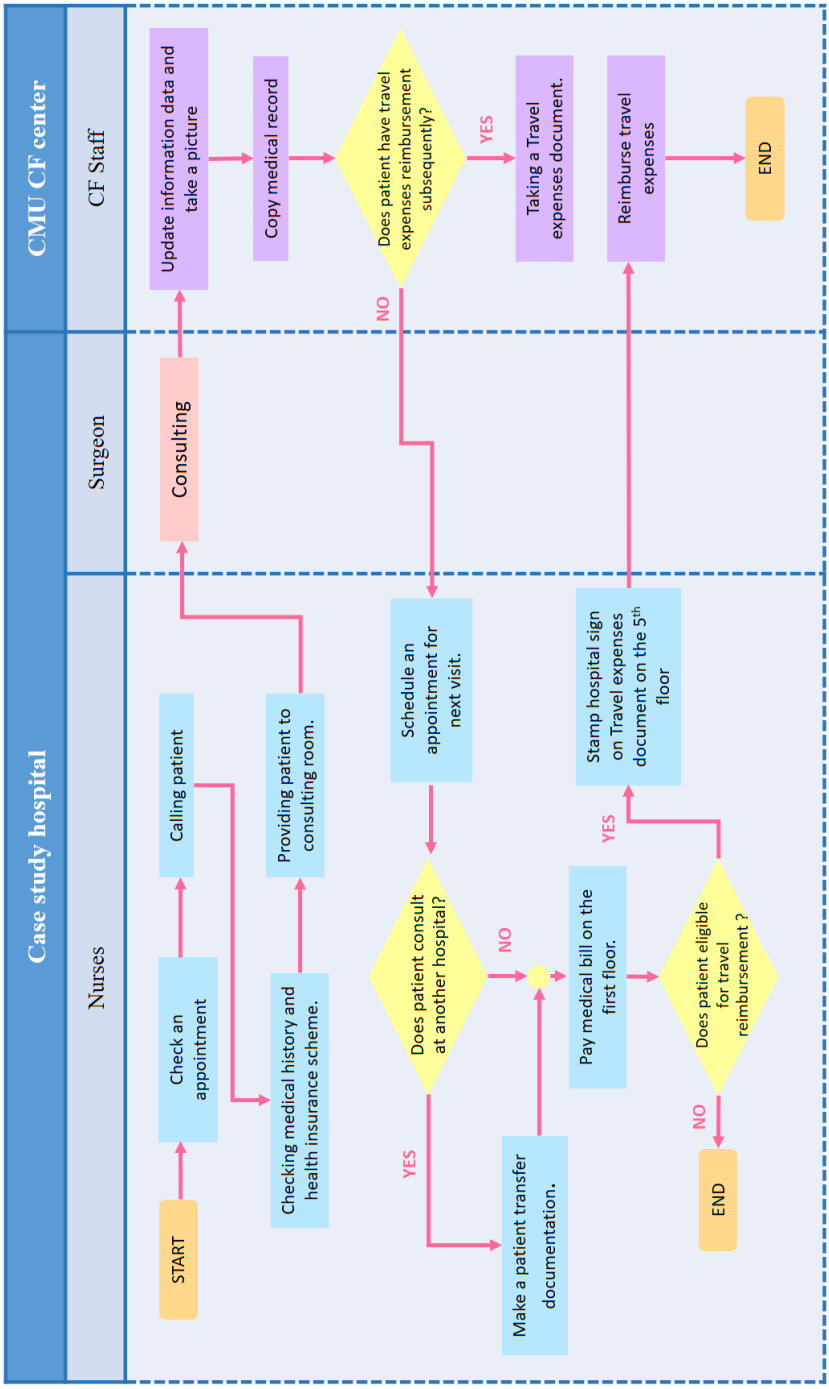

Fig. 3. Outpatient department workflow

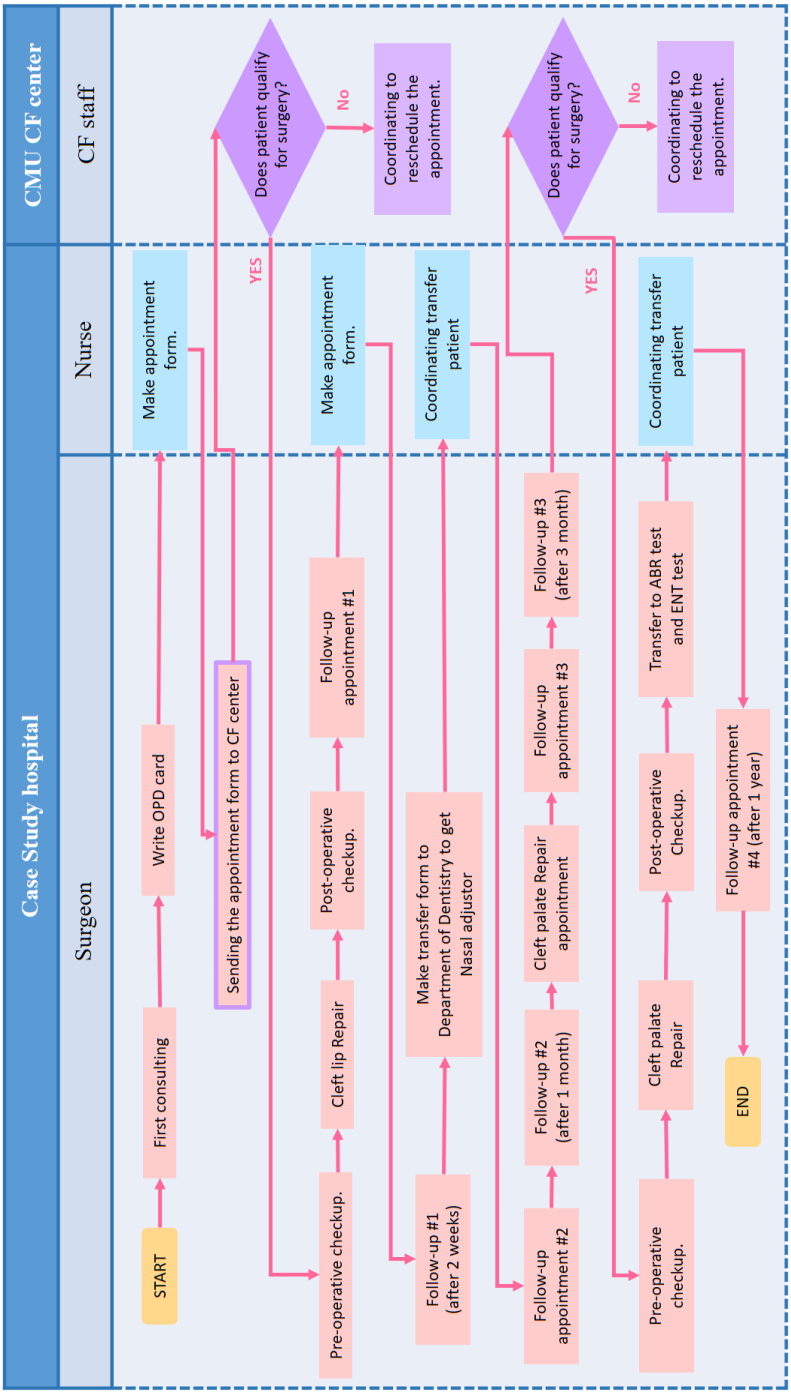

Fig. 4. Surgical department workflow

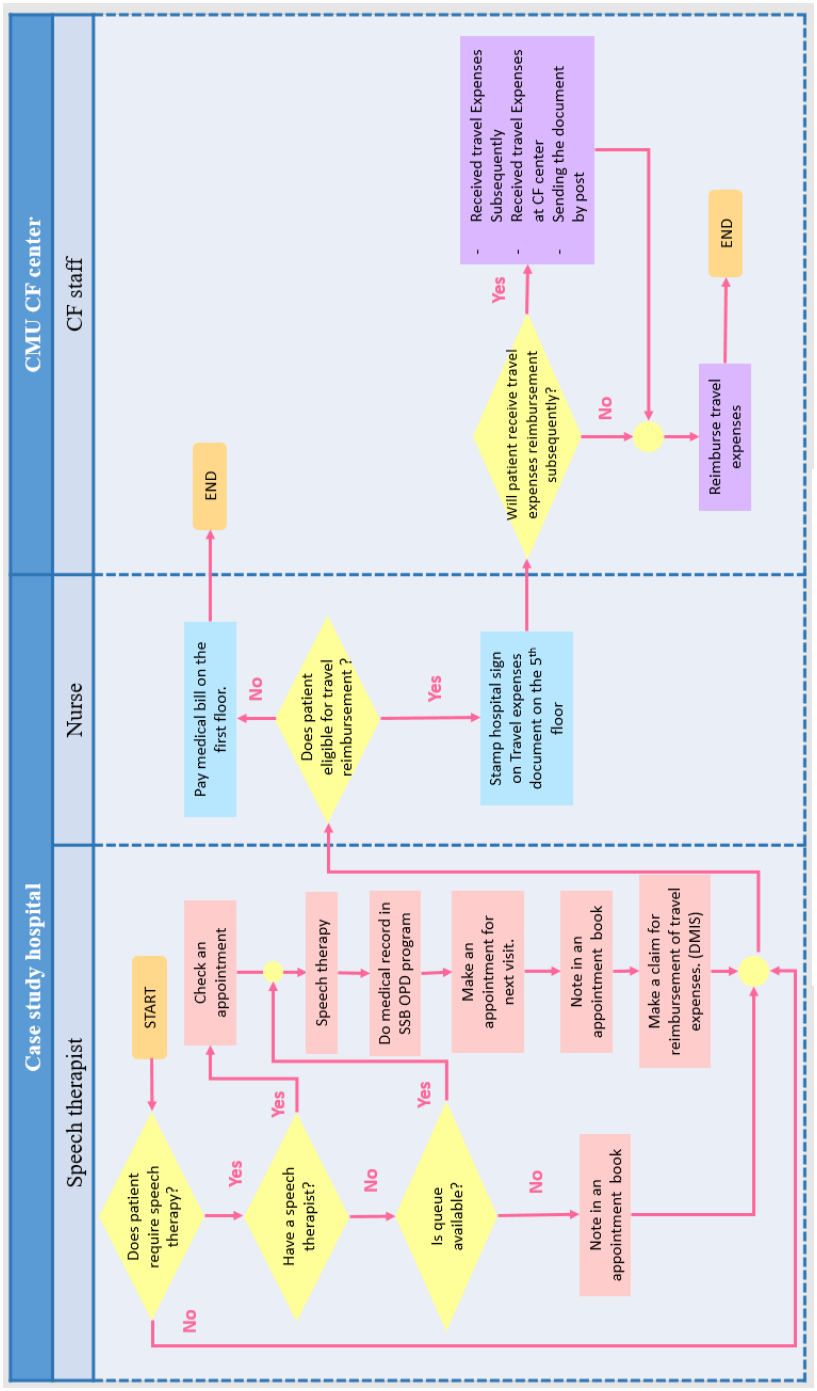

Fig. 5. Speech training department workflow

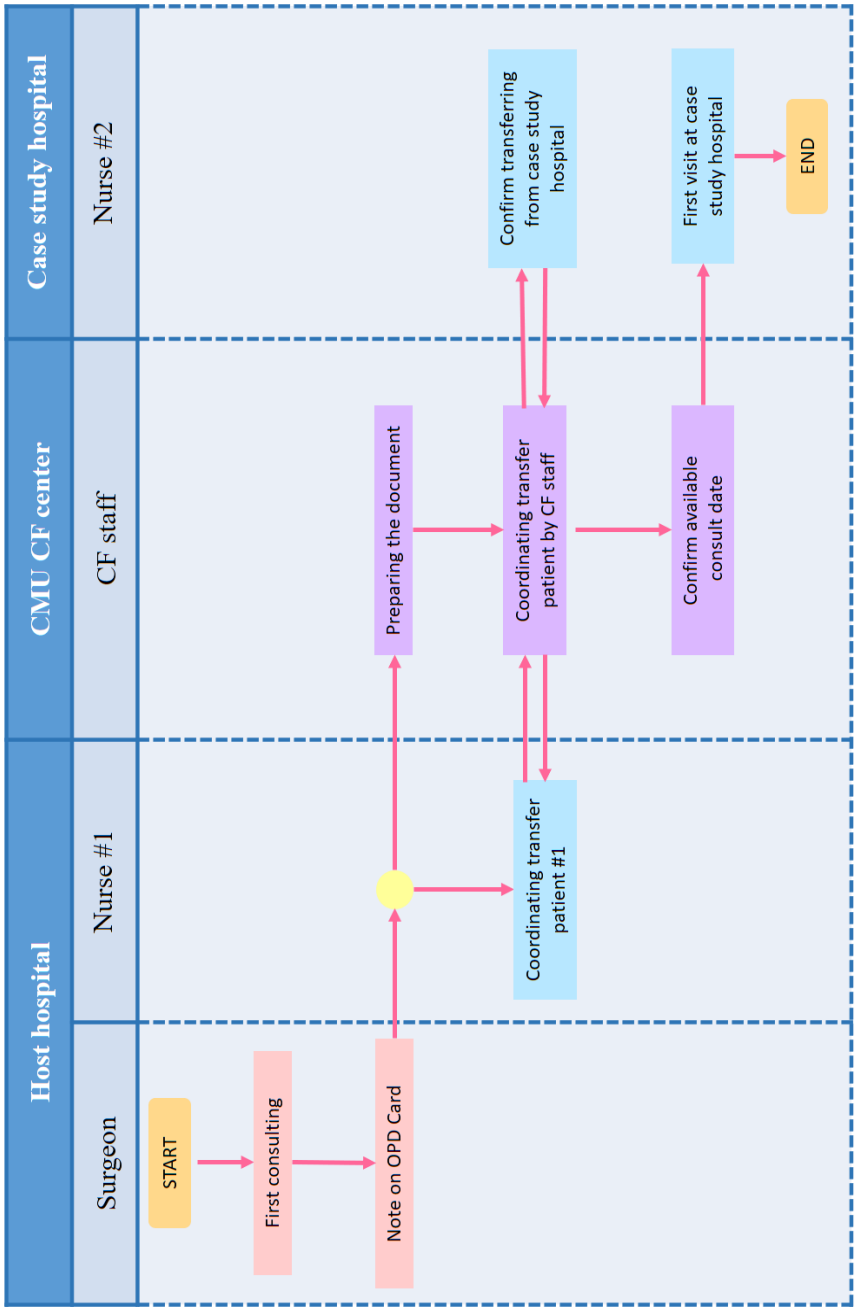

Fig. 6. Patient transfer procedure workflow

3.3. Analysis of current working situation

The Lean concept was applied during this stage. This concept is widely used in operations improvement. Also, in healthcare operations management, the concept of Lean was applied, for example, by Chan et al. (2014), Dart (2011), and Jennifer and Tania (2017). There were three tasks carried out in this study. The first task was to classify all activity along work flows as value-added (VA), non-value-added (NVA), and non-value-added but necessary (NNVA) activities. The second task was to classify the forms of information flow. The last task was to analyze the operations flow of the transfer process. The results were explained as follows:

– Activity classification: all activities from the previous stage were analyzed and classified as VA, NVA, and NNVA and presented as table 3 and figure 7.

Table 3. The activities in a patient's treatment service

No.	Activity	Information/Document	Process activity
1	Check an appointment	Appointment letter	NNVA
2	Calling patient		NNVA
3	Checking medical history and health insurance scheme	Hospital database	NNVA
4	Providing patient to consulting room.		NNVA
5	Consulting		VA
6	Update information data and take a picture	TCL database	NNVA
7	Copy medical record	OPD card, TCL database	NNVA
8	Taking a Travel expenses document.	Travel expenses document	NNVA
9	Schedule an appointment for next visit.	Appointment letter,Hospital database	VA
10	Make a patient transfer documentation.	Transfer form	VA
11	Stamp hospital sign on Travel expenses document on the 5th floor	Travel expenses document	NNVA
12	Pay medical bill on the first floor.		VA
13	Reimburse travel expenses	Travel expenses document	VA
14	Consult at another hospital.	Transfer form	VA
15	Coordinating clinic and surgery appointments.	Transfer form	VA
16	Pre-operative checkup.		VA
17	Asking Patients to Sign Consent Forms.	Consent Forms	NNVA
18	Operation		VA
19	Post-operative checkup.	Medical form	VA
20	Write OPD card	OPD Card	NNVA
21	Sending the appointment form to CF center	Appointment letter,Line	NNVA
22	Follow-up appointment #1	Appointment letter, TCL database,Line ,Phone call	NNVA
23	Follow-up #1 (after 2 weeks)	Appointment letter	NNVA
24	Make transfer form to Department of Dentistry to get Nasal adjustor	Transfer form	NNVA
25	Coordinating transfer patient	Transfer form,Line,Phone call	NNVA
26	Follow-up appointment #2	Appointment letter, TCL database,Line ,Phone call	NNVA
27	Follow-up #2 (after 1 month)	Appointment letter	NNVA
28	Follow-up appointment #3	Appointment letter, TCL database,Line ,Phone call	NNVA
29	Follow-up #3 (after 3 month)	Appointment letter	NNVA
30	Transfer to ABR test and ENT test	Transfer form	NNVA
31	Follow-up appointment #4 (after 1 year)	Appointment letter, TCL database,Line ,Phone call	NNVA
32	Note in an appointment book	Appointment letter	NVA
33	Speech therapy	Medical form	VA
34	Do medical record in SSB OPD program	Medical form	NNVA

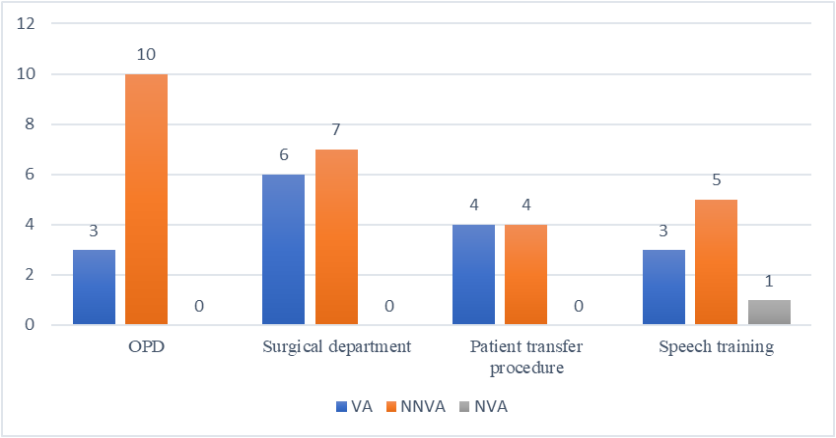

Fig. 7. Activities classification (current)

– Type of information classification: a hard copy document is a classical form of information, however, this form makes it difficult in terms of tracking and storing data for future use. Data/information should be stored in the form of soft copy/electronic through the database of the TCL system provided by the CMU CF center. Thus, all documents and information used during the current treatment procedure were classified (fig. 8).

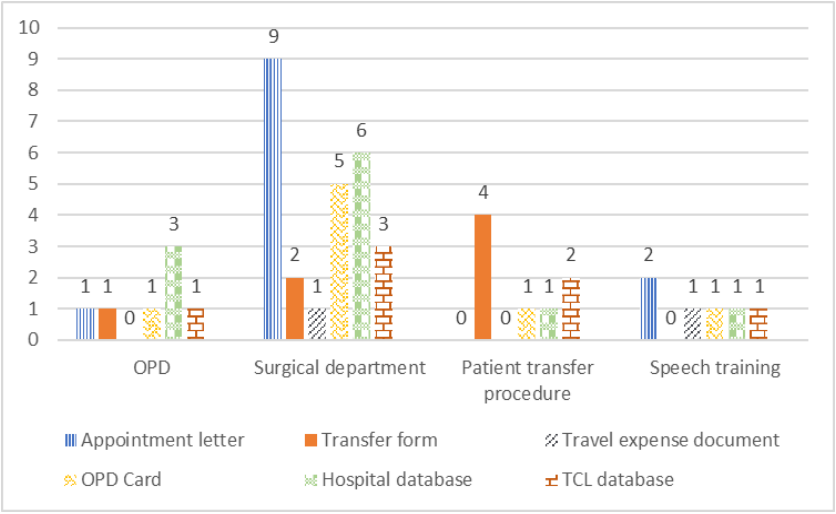

Fig. 8. Information type classification (current)

Figure 8 shows that there was a total of 46 information/documents, from that 28 documents were stored as hard copies and 18 documents as soft copies/electronic stored in both the hospital and TCL databases. Information in the form of a hard

copy should be stored in an electronic form via the TCL system. Currently, only 7 types of information are stored in the TCL system.

– Analysis of patient transfer process: the operation chart was used to represent the sequence of operations to be performed on a component. It gives a view of the various operations, inspections, and storage done in sequence for all the components (Kiran, 2019).

Focusing on the patient transfer procedure, 20 referred patients were studied. The average lead time from when the host hospital requests to transfer patients until they are admitted to the case study hospital was about 110 days (4 months) which resulted in delays in the treatment protocol. The operation chart of the transfer process is presented in table 4, when the total process time considering only workflow is 1 day 2 hours 25 minutes, including operation 6 steps and delay 2 steps.

From table 4, when patients need to be transferred, the doctor at the host hospital should contact the CMU CF center. The staff of the center has to check the patient's medical insurance. After that, the staff will contact the case study hospital by phone. Then, the staff usually waits for information regarding the available time/schedule of the doctor at the case study hospital and calls back to confirm an appointment to the host hospital. When the doctor at the host hospital receives the appointment, patients are informed of the appointment. Finally, the staff of the CMU CF center inputs the appointment to the TCL system.

Table 4. Patient transfer operation chart (current)

Transferring the patient between network hospital process		Improvement summary table			
		Activities	**Before**	**After**	**Difference**
		Operation ○	6	-	-
Activities: Phone call, Data recording		Transportation ⇨	-	-	-
		Delay D	2	-	-
Location: Craniofacial Center		Inspection □	1	-	-
		Storage ▽	-	-	-
Date: 13/02/2021		**Time(min)**	1 day 2 hour 25 min	-	-
Description of process	**Time**	**Symbol**					**Number of Operation**
		○	⇨	D	□	▽	
The host hospital contacts the CF center for a transfer	15 min	●					1
CF center checks the patient's medical insurance	25 min	●					1
CF center contacts the case study hospital	20 min	●					1
CF center waits for information regarding the available time	1 day			●			1
Case study hospital informs of the available time	10 min	●					1
CF center contacts the host hospital to inform of the appointment	10 min	●					1
CF center waits for the host hospital to inform the patient	60 min			●			1
CF center inputs the appointment to the TCL database	5 min	●					1
Total	1 day 2 hour 25 min	6		2			

3.4. Improvement evaluation

After analyzing the current working situation, improvements were proposed and evaluated as follows.

– Using the TCL system for scheduling the appointment and patient's referrals.

Currently, the TCL system provides modules for making an appointment and referring patients but these two functions are not implemented for networking hospitals. Thus, when the case study hospital was able to connect to the TCL system, applying these two modules helped reduce the number of activities from 34 to 32 activities including 11 VA and 21 NNVA (fig. 9).

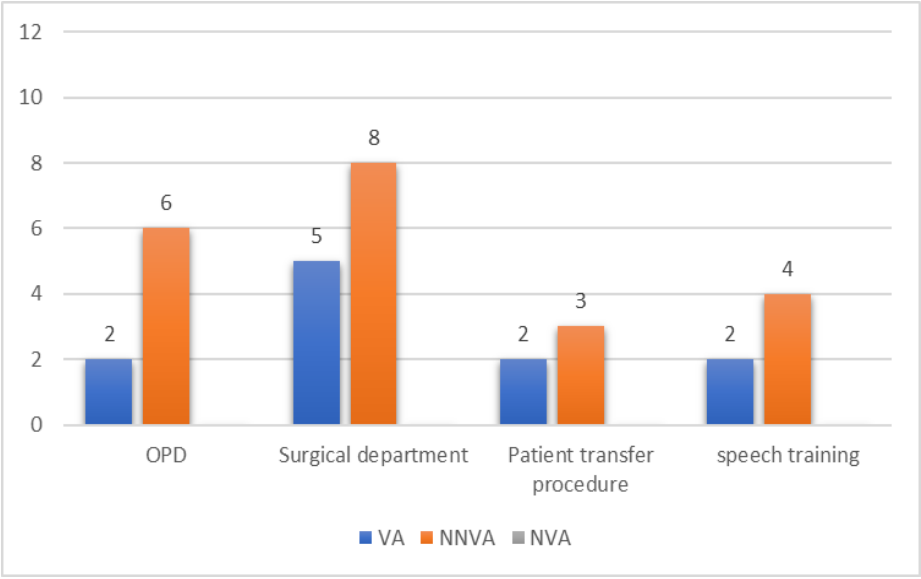

Fig. 9. Activities classification (improved)

1 NVA and 1 NNVA were eliminated when manual works were changed to be performed via the TCL system. The total information after improvement was decreased from 46 to 45 information/documents – these include 22 documents in hard copies (reduced from 28) and 23 documents in the form of soft copies/electronic stored in the hospital and TCL databases (increased from 18) (fig. 10).

– Improvement of the patient transfer process.

The total processing time of a patient's transfer process was reduced to 2 hours 20 minutes including operation 6 steps, delay 1 step, and inspection 1 step. Table 5 shows that the delay was eliminated in 1 step when the available time can be checked via the TCL system and the waiting time can be eliminated. Moreover, when the appointments are recorded in the TCL, patients can be monitored and tracked by the staff that may reduce delay at each treatment step.

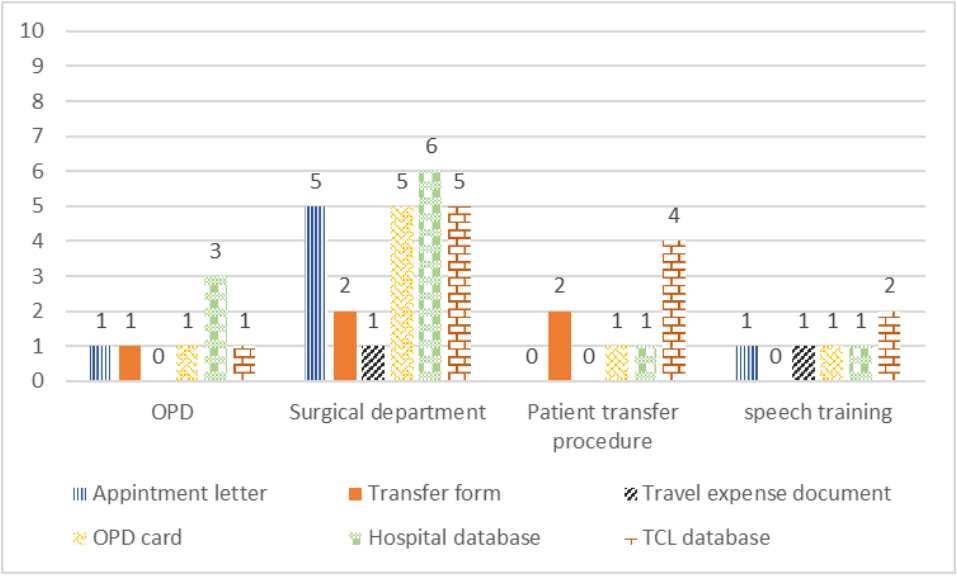

Fig. 10. Information type classification (improved)

Table 5. Patient transfer operation chart (improved)

Transferring the patient between network hospital process		Improvement summary table			
		Activities	Before	After	Difference
		Operation ○	6	6	0
Activities: Data recording		Transportation ⇨	-	-	-
		Delay D	2	1	1
Location: Craniofacial Center		Inspection □	-	1	1
		Storage ▽	-	-	-
Date: 20/04/2021		**Time(min)**	1 day 2 hour 25 min	2 hour 20 min	1 day 5 min

Description of process	Time	Symbol					Number of Operation
		○	⇨	D	□	▽	
The host hospital contacts the CF center for a transfer	15 min						1
CF center checks the patient's medical insurance	25 min						1
CF center checks the treatment schedule from the TCL database	10 min						1
The case study hospital informs of the available time	10 min						1
CF center contacts the host hospital to inform of the appointment	10 min						1
CF center waits for the host hospital to inform the patient	60 min						1
CF center inputs the appointment on the calendar in the TCL	5 min						1
Follow up of the patient's first visit at the case study hospital	5 min						1
Total	2 hour 20 min	6		1	1		

4. CONCLUSION

In conclusion, the objective of this research was to improve supporting operations for cleft lip and cleft palate healthcare services. For the 9 provinces in the northern region of Thailand, the CMU CF center was established to be a one-stop service for the patients. This center works as the coordinator among hospitals in the service network with patients.

Supporting operation flows were analyzed and improved based on the Lean concept. Standard working procedures were set up. The introduction of an IT solution, the TCL system, was the key to patients receiving on-time treatment and facilitating data flow throughout the treatment plan.

The results of this study show that when the operations flows were improved, and the TCL system was extended to be employed at the case study hospital, the operation time of supporting operations can be reduced. In this case, we can only present the approximated time of the improved procedures. Although the delay time for patients cannot be directly measured, patients can be tracked by the system, and the CF center can monitor patients and remind them of their appointments. We believe that this improvement can help reduce the number of patients who have delays in the treatment plan and the delay time in the treatment plan.

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POPRAWA SYSTEMU OPIEKI ZDROWOTNEJ NA PRZYKŁADZIE SIECI SZPITALI W GÓRNYM PÓŁNOCNYM REGIONIE TAJLANDII

Streszczenie

Rozszczep wargi i/lub rozszczep podniebienia to najczęstsze wrodzone wady twarzoczaszki. Szacuje się, że w Tajlandii corocznie ten problem dotyka dwóch spośród tysiąca dzieci. Centrum Twarzoczaszki Uniwersytetu Chiang Mai (CMU CF) realizuje kompleksową obsługę opieki zdrowotnej w tym zakresie. Ośrodek ten pełni także funkcję koordynatora wśród szpitali leczących tę dolegliwość. Niniejsze badanie ma na celu zmniejszenie opóźnienia w realizacji planów leczenia pacjentów i jest studium przypadku jednego ze szpitali w sieci. Na drodze przeprowadzonej identyfikacji problemu stwierdzono, że dwa etapy leczenia, w tym badanie słuchu (ABR/OAE) i cheiloplastyka, stanowiły 80% całkowitego opóźnienia spośród zgromadzonych danych. Następnie wykonano analizę przyczynową, przeprowadzono wywiady ze specjalistami i zbadano dokumentację pacjentów. Głównym powodem opóźnienia procesu leczenia okazało się przenoszenie pacjentów z innych szpitali na obszarach wiejskich do badanego szpitala. W szczególności newralgiczne okazały się czynności pomocnicze, które służą obsłudze pacjentów i wymagają współpracy pomiędzy badanym szpitalem a ośrodkiem CMU CF. Czynności te, obejmujące cztery fazy, zostały zbadane i udoskonalone na podstawie koncepcji Lean. Ustalono standardowe procedury, wyeliminowano działania nieprzynoszące wartości i usprawniono te, które przynoszą wartość, przez wdrożenie rozwiązania informatycznego. Ostatecznie ustalono, że gdy czynności pomocnicze są realizowane za pośrednictwem rozwiązania informatycznego, czas przetwarzania może ulec skróceniu. Ponadto wdrożenie rozwiązania informatycznego pomaga w śledzeniu i monitorowaniu stanu pacjenta, co prowadzi również do zmniejszenia liczby opóźnionych pacjentów i skrócenia czasu opóźnienia w stosunku do założonego planu leczenia.

Słowa kluczowe: e-zdrowie, protokoły i komunikacja informacyjna, procedury planowania procesów, zasady organizacji w sieci