UNIVERSITI PUTRA MALAYSIA

OPERATION EFFICIENCY ANALYSIS OF THE SMALL ANIMAL CLINIC, UNIVERSITY VETERINARY HOSPITAL

LIM ZHI JIAN

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By

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CERTIFICATION

It is hereby certified that I have read this project paper entitled "Operation Efficiency Analysis of the Small Animal Clinic, University Veterinary Hospital" by Lim Zhi Jian and in my opinion it is satisfactory in term of scope, quality, and presentation as partial fulfillment of the requirement for the course VPD 4901 – Project.

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DEDICATION

Thanks to my family and friends, for the faith and endless care they give me.

Always……

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ABSTRACT

An abstract of the project paper presented to the Faculty of Veterinary Medicine in partial fulfillment of the course VPD 4999-Project

OPERATION EFFICIENCY ANALYSIS OF THE SMALL ANIMAL CLINIC, UNIVERSITY VETERINARY HOSPITAL

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2015

Supervisor: Associate Prof. Dr. Goh Yong Meng

Turnaround time (TAT) is an important determinant for workflow efficiencies in various healthcare facilities, including veterinary facilities. The objectives of this study were to determine the TAT of different service stations during consultation and treatment at the Small Animal Clinic (SAC), University Veterinary Hospital (UVH), and to identify possible factors that affect the TAT at each service station. A clinical workflow structure was established and each service station was defined. The service stations are reception, examination/biopsy/treatment, minilab, X-ray/ultrasound, interpretation and diagnosis, verification/dispensary, payment, and dispensary. TAT data was recorded for each service station during consultation using both computerized and manual recording methods. Details of the cases and other relevant information were recorded. The dataset was then analyzed using SPSS version 20. The mean TATs for each service station ranged from 1.96 mins (dispensary) to 42.10 mins (reception). Factors that determined TATs included the attributes of cases and human resource factors. The average revenue

per cases for the duration of the study was RM 166.10 per case, with the highest recorded on Mondays (RM 194.23) and lowest on Saturdays (RM 77.99). In conclusion, this study showed that the TAT is closely related to the nature of cases and inputs in human resource. Therefore the current findings could be use as a reference to further improve the service efficiencies of the SAC, UVH.

Keywords: turnaround time, nature of cases, human resources, revenue, small animal clinic

ABSTRAK

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sabahagian daripada keperluan kursus VPD 4901 - Projek

ANALISIS KECEKAPAN OPERASI DI KLINIK HAIWAN KESAYANGAN, HOSPITAL VETERINAR UNIVERSITI

By

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2015

Penyelia: Associate Prof. Dr. Goh Yong Meng

Masa pusingan merupakan satu penentu yang amat penting untuk kecekapan aliran kerja dalam kemudahan kesihatan, termasuk kemudahan veterinar. Objektif kajian ini adalah untuk menentukan masa pusingan daripada stesen-stesen perkhidmatan semasa sesi konsultasi dan rawatan di Klink Haiwan Kesayangan (KHK), Hospital Veterinar Universiti (UVH) dan mengenal pasti factor-faktor yang mungkin akan mempengaruhi masa pusingan di setiap stesen perkhidmatan. Satu struktur aliran kerja klinical telah ditubuhkan dan setiap stesen perkhidmatan telah ditentukan. Stesen perkhidmatan adalah kounter penerimaan, pemeriksaan, minilab, X-ray/ultrasound, interpretasi dan diagnosis, pengesahan/dispensary, pembayaran, dan dispensari. Data masa pusingan telah direkod untuk setiap stesen perkhidmatan semasa konsultasi menggunakan kedua-dua cara, iaitu cara berkomputer dan cara rekod manual. Semua factor-faktor juga direkodkan. Kemudian, data analisis telah dijalankan mengguna SPSS versi 20. Purata

masa pusingan untuk setiap stesen perkhidmatan mempunyai julat daripada 1.96 minit (dispensari) ke 42.10 minit (kounter penerimaan). Faktor-faktor yang mempunyai pengaruh pada masa pusingan telah dibahagikan kepada dua kategori, iaitu faktor berkaitan dengan ciri-ciri kes dan faktor berkaitan dengan sumber manusia .Purata pendapatan per kes semasa kajian dijalankan adalah RM 166.10 per kes, dengan rekod tertinggi pada hari Isnin (RM 199.23), dan rekod terendah pada hari Sabtu (RM 77.99). Kesimpulannya, kajian ini menunjukkan masa pusingan ada perkaitan yang rapat dengan cirri-ciri kes dan sumber manusia. Oleh itu, keputusan semasa boleh digunakan sebagai rujukan untuk meningkatkan kecekapan perkhidmatan di KHK, UVH.

Kata kunci: masa pusingan, ciri-ciri kes, sumber manusia, pendapatan, klinik haiwan kesayangan

1.0 INTRODUCTION

University Veterinary Hospital (UVH) was established in 1975 by the Faculty of Veterinary Medicine and Animal Science, University Pertanian Malaysia (now known as University Putra Malaysia). The Small Animal Clinic (SAC) is one of the units in UVH. It provides various services for outpatient cases, and also directs patients that need further diagnostic investigation and treatment to the wards in the hospital. The SAC comprises of two separate reception counters, one for canine and the others for feline and between 8-10 consultation rooms. The SAC also has a minilab for simple diagnostic procedures, and it is connected to the radiology unit for the purpose of diagnostic imaging. The number of cases for the small animal clinic and UVH as a whole has been growing. In fact, the SAC, UVH recorded a 4.6 % growth in the number of small animal cases to 11554 cases in 2014, compared to a total of 11028 cases in 2013. Canine cases recorded significant increase of about 13.3 % from 3112 cases in 2013 to 3590 in 2014. Correspondingly, feline cases only showed a marginal increase of about 0.6 % from 7916 cases to 7964 cases in 2014. In terms of income, the UVH as a whole generated RM 1.556 million in 2011, and this grew by 48 % to RM 2.309 million in 2014. These are further testament to the necessity and relevancy of the services provided by the SAC and the entire UVH to the general public.

Successful operation of SAC requires adequate human resources, medical equipments, drugs, and other relevant instruments. With increasing cost of operation in veterinary hospital, it must be operating at its optimum capacity in order to generate maximum profitability. After a few decades of operation, this study represents the faculty's pioneering effort to determine the efficiency of clinical

workflow in the SAC, UVH. In order for UVH to have a long term goal to achieve maximum profitability using its optimum capacity, detailed study of the operational efficiency of clinical workflow of the SAC is necessary.

Since the 1980s, the efficiency of laboratory or pathological services is commonly evaluated by turnaround time (TAT) to quantify the time for laboratory tests in an objective manner (Bloch, 1982). A study done by Pati & Singh (2014) states that one of the indicators for the evaluation of quality and efficiency of the laboratory investigations is timeliness, which is commonly measured by using TAT. Many publications had been focusing on using TAT as an indicator for the evaluation of quality and efficiency in different health care industries, such as in emergency department (ED) human hospital (Rapoport *et al*., 2003), patient cycle time in a tertiary diabetes center (Tse, 2014), and also in the workflow of radiology unit (Halsted & Froehle, 2008). All these studies demonstrate that the application of TAT is not limited for pathology and laboratory services only.

Thus, in veterinary hospital setting, TAT can be measured in order to analyze the efficiency of workflow, and also to identify weak points in the hospital system for the improvement the entire system.

The overall objectives of this study were: -

1. To determine the TAT of different service stations during consultation and treatment at the SAC, UVH.
2. To identify possible factors that can affect the TAT at each service station.

2.0 LITERATURE REVIEW

2.1 Defining Turnaround Time (TAT)

TAT can be defined as "period for completing a process cycle, commonly expressed as an average of previous such periods" (BusinessDictionary.com, 2015). TAT is generally used in shipping and airline industry implying the time the ship or plane is ready for the return journey.

The first definition of TAT can be dated from 1971, which is used in electrocardiography processing. It describes TAT as the time interval between electrocardiogram printing and placement of the printout in the patient chart (Tell & Hoffman, 1971). Hence, it can be seen that the definitions of TAT vary among different settings. In medical laboratory setting, TAT can be defined as the time taken to complete a test (Pati & Singh, 2014). In a study done by Westbrook *et al.* in 2008 for the evaluation of the laboratory efficiency, TAT is defined as the "time from receipt of the specimen" until "time of the availability of the result". Another study done for the radiology unit of human hospital, the TAT is defined as the "sum of the time that elapses between the moment an imaging exam is ordered, its execution time, and the reporting time" (Nitrosi *et al*., 2007). Pati & Singh (2014) also describes pre-analytical, analytical, and post-analytical phases as a whole, which is the therapeutic TAT. Therapeutic TAT is defined as the "interval between the time a test is ordered to the time when treatment decision are made based on the result available" (Fermann & Suyama, 2002).

Between clinicians and laboratory professionals, there are also differences in their definitions of TAT. According to Steindel & Howanitz (2001), 41.1% of laboratories defined TAT as the "time of receipt in the laboratory until time of report". Another

27% of them defined it as the “ordering of test until result reporting” and 18.2% as “specimen collection to time of report”. In the same study, states that in the point of view of physicians, however, over 40% of them defined TAT as “starting at physician request until reporting” and only 9% defined the TAT at “laboratory receipt”.

This difference in the definition of laboratory TAT between clinicians and laboratory professionals is mainly due to the different perceptions to the TAT itself. Generally, a laboratory will frequently define TAT as the “starting from the time it receives the sample until the time when result is available” (Pati & Singh, 2014). This definition restricts the activities which happen in the laboratory only. Laboratory often argues that the events which are happening outside the laboratory are not within their control (Saxena & Wong, 1993). Pre-analytical processes such as ordering of test, transportation of the sample, and so on are unlikely to be regulated by the laboratory. Similarly, post-analytic processes such as durations of interpretation and action taken by the physician are also beyond their scope.

An important fact is often overlooked by the laboratory is that 90 to 96% of total TAT is made up of pre-analytical delays which happen outside the laboratory (Valenstein, 1990). Most laboratories’ approaches define the TAT that only include intra-laboratory activities may significantly underestimate the actual TAT.

The main reason that leads to various definitions for TAT used is because different studies need different starting and ending points for specific procedures or processes in different facilities. It is reasonable to use different definitions for TAT in evaluating certain systems or operations; however, the definition needs to be defined

precisely. The use of various definitions as well as synonyms and homonyms make the comparison between similar facilities becomes difficult (Breil *et al*., 2011).

2.2 Classification of Turnaround Time (TAT) in Laboratory Setting

In a laboratory and clinical settings, TAT can be classified by the types of test. For example, the priority of the test, whether it is urgent or routine; the population served, such as inpatient, outpatient, or ED; and lastly, the activities included (Hawkins, 2007).

There is also another classification for the TAT, where it separates the steps into three phases, which are the pre-analytical, analytical, and post-analytical phases (Manor, 1999). The pre-analytical phase includes sampling procedure done by the physician, transportation of the sample, and various other processes which are carried out before the sample arrived at the laboratory. Analytical phase covers mostly the different levels of investigation processes involving various methods in a laboratory. Post-analytical phase is made up by the interpretation and the action carried out by the physicians. However, most studies can agree that TAT is a useful indicator for efficiency.

2.3 Methods to Measure Turnaround Time (TAT)

As there are a lot of studies which had done regarding TAT in different healthcare facilities, the presence of variation in the methods of measurement of TAT is inevitable. Basically, the methods can be categorized into two main groups, which is the utilization of the computerized system of the facility, for example, hospital information system (HIS) and the manual recording method.

Computerized system is used in many studies in order to extract time data for the starting points and ending points for certain processes. A research done by Nitrosi *et al.* (2007) used the time data from HIS for the study of the relationship between the radiology TAT and the length of hospital stay of patients. Another study done by Halsted & Froehle (2008) used radiology information system (RIS) to obtain time stamp data for the radiology process which were routinely recorded. In another study in a tertiary diabetes center (Tse, 2014), the TAT was calculated by obtaining the time difference from time of registration to time of payment captured through the electronic queuing and billing system.

Few studies used manual record method, most probably because of the absence of a compaterized system. A research which studied about the relationship of wait time and satisfaction of patient used "patient care time flow sheet", which the use of this sheet was to record the tme if entry into the clinic until departure from it. Then the amounts of time patients waited at various points in the clinic were calculated by substracting the actual clock times recorded (Cole *et al*., 2001). Goswani *et al*. (2010) used TAT logbook from the laboratory to extract TAT data for their research.

Some health care facilities are equipped with computerized system, however, the system does not cover the entire network of the hospital, thus they used the combination of both methods. In one study, for example, the time of physicians order the test was manually written by the physicians themselves on the patient charts, then the time data was extracted retrospectively. The other time data in the study was recorded by the hospital computer network (Jalili *et al*., 2012).

2.4 Importance of Turnaround Time (TAT) in Healthcare Facilities

TAT is crucial element in healthcare facilities. Most clinicians judge the quality of a laboratory service by the speed with which the results are reported (Novis & Dale, 2000). Point-of-care measurements are costly and have less precise results compare to the one in the central laboratory. However, due to the rapidness of the test, the advantage outweighs the disadvantage. (Howanitz & Howanitz, 2001).

Unacceptable TAT will induce dissatisfaction of both the clinicians as well as the patients. In a study done by Howanitz et al. (1993) revealed that 87% of the clinicians, mostly from the ED, are unsatisfied because of the slow TAT of the laboratory. Cole *et al.* (2001) states that there is an inverse relationship between waiting time and satisfaction level of the patients. When waiting time is less than expected, the patients reported higher levels of satisfaction (Thompson *et al*., 1996).

Manor (1999) states that insufficient TAT will affect patient care on many levels. Decreased in TAT will hasten the availability of the result, thus, improve the clinician efficiency for the patient diagnosis and treatment adjustment (Howanitz & Howanitz, 2001).

3.0 MATERIALS AND METHODS

General Overview

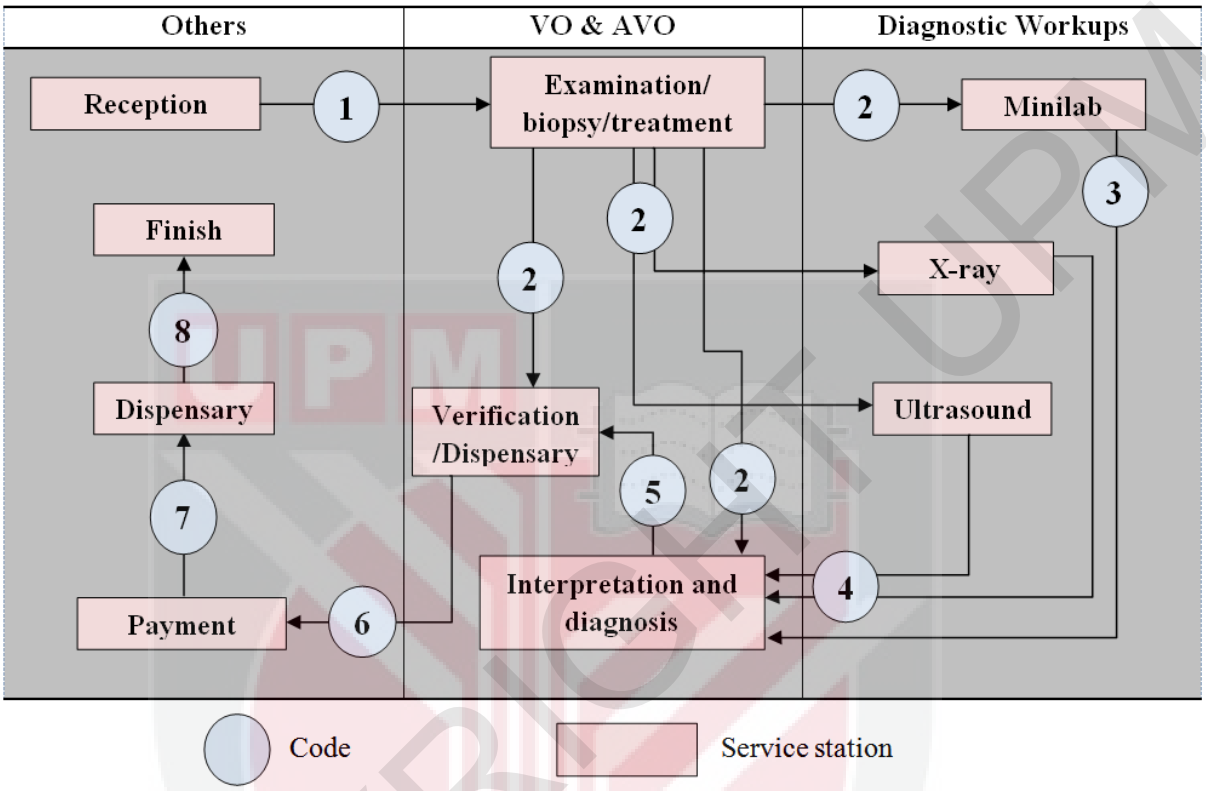
In order to facilitate data collection in the current study, the reception, consultation and follow up diagnostic work, as well as dispensary and payment activities of a typical case at the SAC, UVH was broken up into 8 distinct activities – or service stations. Through this approach, this study was able to focus on the measurement of TAT of each service station as an indicator of efficiency. Details for each of the

service station are as outlined in 3.1. Data was taken during the SAC's operating hours (Monday to Friday 8.30a.m. to 5.00a.m., Saturday 8.30a.m. to 1p.m.), from Monday to Saturday. The data collection period lasted over a period of 3 weeks (12th January to 30th January 2015).

3.1 Establishment of a Clinical Workflow Structure for SAC, UVH

According to Pati & Singh (2014), the measurement of TAT starts with establishing a definition of TAT for the specific institution. Firstly, overall clinical workflow of SAC was identified by taking into consideration for all the possible service stations that clients may go through in SAC. Then, each identified service station was defined, given a check in point and check out point in order for TAT to be recorded. Check in time (CIT) is the time when a service station is started and time is recorded, whereas check out time (COT) is when a service station is finished and time is again recorded. A total of eight service stations were identified in SAC for this study. The clinical workflow chart of SAC, UVH is as shown in Figure 1. The service stations are represented by rectangular boxes, while the circles are for the code, the number in the circle indicates the code for the particular service station. For example, code 1 stands for station 1, which also means the TAT for the station, which in this case is the reception.

Figure 1: Clinical workflow at the SAC, UVH



3.1.1 Definitions for Service Stations

3.1.1.1 Reception

Reception is the first service station where the clients register themselves and wait to be ordered into the consultation room. The CIT is when the clients get the queue number (time from the electronic queue system), and the COT is when they are ordered and enter into the consultation room.

3.1.1.2 Examination/biopsy/treatment

The next station after reception is examination/biopsy/treatment station. This is the station where the veterinary officer (VO) and assistant veterinary officer (AVO) start to do examination, treatment, take biopsy, and fill in request form for radiology unit and/or other laboratories. This CIT for this station is when the VO starts history

taking and general/specific examination, and the COT is when the sample/animal leaves the consultation room to X-ray/ultrasound and minilab or when treatment is done. The other COT is when the clients leave the consultation, as in some cases no diagnosis workup or treatment will be given.

From the examination/biopsy/treatment station, it is branched into three other service stations, which are the X-ray/ultrasound and minilab stations. Clients may go through only one of the service stations, or the any combination of the three service stations mentioned.

3.1.1.3 Minilab

Minilab is where the VO or AVO can process biopsy, such as skin scraping, hair pluck, diff quick staining, process blood sample for quick packed cell volume, microscopic examination for slides, and so on. The CIT for minilab is when the biopsy leaves the consultation room, and the COT is when the result of the biopsy is available and VO is back to the consultation room.

3.1.1.4 X-ray/ultrasound

X-ray/ultrasound station is where the animal is sent to the radiology unit for the purpose of diagnostic imaging. For X-ray, CIT for this station is when the animal leaves the consultation room to the radiology unit and the COT is when the result is back and interpreted by the VO. In case of ultrasonography, the CIT is the as X-ray, but the COT is when the client is back to the consultation room with the VO.

3.1.1.5 Interpretation and Diagnosis

Interpretation and diagnosis station is where the results from X-ray/ultrasound and/or minilab is available and arrive at the consultation room. Then, the diagnosis is made from the result, and the VO will interpret and discuss the findings with clients.

Treatment may also be done after result is back, and then decide whether this is an inpatient or outpatient case. The CIT for this service station is when all the results (radiograph, thin blood smear, and etc.) arrive at the consultation room and/or when the treatment is finished. The COT is when the clients leave the consultation room to wait for the payment station.

3.1.1.6 Verification/dispensary

The next station is the verification/pharmacy station. This is the station where VO and AVO fill in, summarize, and sign the relevant documents for the client, and also prepare the medications. The CIT for this service station is when the clients leave the consultation room and the VO and AVO start to summarize and verify the documents, and the COT is when the relevant documents are sent to the reception counter for payment.

3.1.1.7 Payment

Payment station is where the receptionist generates payment documents from the UVH financial system using computer, and the clients will pay and get a receipt. This is the last station if the clients do not go to dispensary station. The CIT for this station is when the relevant documents are sent to the reception counter, and the COT is when the clients finish payment and receive receipt.

3.1.1.8 Dispensary

Dispensary station is the last station for clients to receive medications and enquire relevant information from the VO or AVO. Not all the clients will go through this station. The CIT for this service station is when the clients reach the dispensary counter and the COT is when the clients leave the dispensary counter.

3.2 Data Collection

The measurement of TAT was collected using the combination of both computerized and manual record method. Time keeping, observation of the entire consultation process (from the first service station to last service station), extraction of information from patient files and logbook, and also enquiries from staff (VO, AVO, and receptionist) were used in this study. The data was collected and collated by the same researcher throughout the study period. Even though this limits the number of cases that can be sampled from the SAC, but it ensures the accuracy of the time keeping and standardization of observation procedures and thus improved the validity of this study.

The TAT was measured based on the clinical workflow chart and definitions of service stations established earlier. CIT and COT for each service station that the clients went through were recorded in a sample collection form, then the TAT of the service station. Other relevant information for the consultation was also recorded in the sample collection form, for examples, the species, type of case, and so on. The number of VO, AVO, and receptionist working on that particular day was also recorded.

3.3 Data Analysis

The dataset collected was analyzed using SPSS version 20. Shapiro-Wilk test was used to ascertain the normality of the dataset. For normally distributed data, independent T-test and 1 way ANOVA were used. For data which was not normally distributed, the Mann Whitney U-test and Kruskal Wallis test were used. All the tests were performed at 95 % confidence level.

4.0 RESULTS

4.1 Overall Demographics

A total of 126 cases were collected during the 3 weeks period. Out of the 126 cases, 50 (39.7%) were canine cases, and 76 (60.3%) were feline cases. All the factors are separated into nature of cases and human resources factors. The factors under nature of cases are days, species, type of cases, and complexity of cases, visit, appointment, and sessions. The human resources' factors are number of VO, number of AVO, number of AVO in dispensary, number of receptionist, number of VO involved in one consultation, and number of AVO involved in one consultation.

4.1.1 Attributes of Cases

4.1.1.1 Days

In general it can be seen that the cumulative number of cases logged on each day of the week increased from Monday and peaked towards Thursday (Table 1). Fridays and Saturdays are considerably quieter days due to their shorter opening hours. On Mondays, a total of 16 cases were recorded, 9 (56.2%) canine cases and 7 (43.8%) feline cases. On Tuesday, out of 28 cases, 6 cases (21.4%) for canine and 22 cases (78.6%) for feline species were collected. There were 14 cases (37.8%) of canine species on Wednesday, whereas feline species had 23 cases (62.2%). On Thursday, 16 cases (53.3%) out of 30 cases were canine species, and the other 14 cases (46.7%) were feline species. On Friday, only 6 cases were collected, and 4 (66.7%) of them were canine, and the other 2 were feline cases. Lastly, on Saturday, only 1 out of 9 cases (11.1%) were canine, feline cases were 8 (88.9%).

Table 1: Case distribution throughout the week during the 3 week study period

	Day						Total
	Mon	Tue	Wed	Thu	Fri	Sat	
Canine	9	6	14	16	4	1	50
Feline	7	22	23	14	2	8	76
Total	16	28	37	30	6	9	126

4.1.1.2 Type of Cases

A total of 25 inpatient cases were recorded, 11 (44.0%) of them were canine, 14 (56.0%) of them were feline cases. Out of 101 outpatient cases, 39 (78.0%) and 62 cases (81.6%) were canine and feline, respectively (Table 2).

Table 2: Species composition of the cases during the study period

	Types of Cases		Total
	Inpatient	Outpatient	
Canine	11	39	50
Feline	14	62	76
Total	25	101	126

4.1.1.3 Complexities and Procedural Differences

The number of cases recorded for surgery cases were the same for both canine and feline, which were 6 cases. For medicine cases, 17 cases (31.5%) were canine, whereas there were 37 feline cases (68.5%). Health care cases for canine and feline were 11 (37.8%) and 18 (62.1%) cases respectively. For revisit cases, 9 cases (56.2%) were canine, and 7 cases (43.8%) were feline. Lastly, the number of cases collected for check up were 15, 7 (46.7%) were canine, 8 (53.3%) were feline (Table 3).

Table 3: Distribution of cases according to procedures and complexities

	Procedures and Complexities					Total
	Surgery	Medicine	Healthcare	Revisit	Check up	
Canine	6	17	11	9	7	50
Feline	6	37	18	7	8	76
Total	12	54	29	16	15	126

4.1.1.4 Group Visit versus Individual Visits

Out of a total of 96 cases of individual visit, 44 (45.8%) of them were canine, and 52 (54.2%) of them were feline species. For group visit, there were only 30 cases. 6 cases (20.0%) were canine, and 24 cases (80.0%) were feline (Table 4).

Table 4: Type of visits

	Visit		Total
	Individual	Group	
Canine	44	6	50
Feline	52	24	76
Total	96	30	126

4.1.1.5 Appointment

There were a total of 92 walk in cases and 34 appointment cases. 34 (37.0%) walk in cases were canine, and 58 (63.0%) were from the feline species. For appointment cases, 16 (47.1%) of them were canine, and 18 (52.9%) were feline species (Table 5).

4.1.1.6 Sessions

A total of 92 cases were collected in the morning session, 37 (40.2%) of them were canine cases, and 55 (59.8%) of them were feline cases. For the afternoon session, 34 cases were collected, canine cases and feline cases were 13 (38.2%) and 21 (61.8%) respectively (Table 5).

Table 5: Time of visit and appointment arrangements

Session			Appointment		Total
			Walk In	Appointment	
Morning	Species	Canine	22	15	37
		Feline	37	18	55
Afternoon	Species	Canine	12	1	13
		Feline	21	0	21
Total	Species	Canine	34	16	50
		Feline	58	18	76
Total			92	34	126

4.1.2 Human Resources

4.1.2.1 Number of Veterinary Officers (VO's)

The potential relationship between the number of VO's available When there was only 1 VO, 9 cases were logged of which 1 (11.1%) was canine, and 8 (88.9%) were feline cases. When there were 3 VO, 9 canine cases (34.6%), and 17 feline cases (65.4%). When there was 4 VO's working, 5 canine cases (26.3%) were collected, and feline cases were 14 (73.7%). When 5 VO were working, canine and feline cases collected were 14 (34.1%) and 27 (65.9%) respectively. In case of 6 VO, 21 (67.7%) feline cases were collected, while only 10 (32.2%) were collected. This showed that the number of cases logged is strongly correlated ($r=0.8088$; $p<0.05$) to the number of VO's available/assigned, further suggesting that the SAC, UVH should capitalize on this phenomenon to further improve revenue generation at the SAC (Table 6).

Table 6: Number of VO's available versus number of cases at the front office during the study period

	VO					Total
	1	3	4	5	6	
Canine	1	9	5	14	21	50
Feline	8	17	14	27	10	76
Total	9	26	19	41	31	126

4.1.2.2 Number of Assistant Veterinary Officers (AVO's)

Similarly, an even higher correlation ($r=0.928$, $p<0.05$) was observed for the number of AVO's available. In the case of 1 AVO, 1(10%) canine case and 9 (90.0%) feline cases were collected. When there were 2 AVO, the number canine and feline cases collected were the same, which were 2 cases. Most cases were collected when there was 4 AVO, 47 (42.0%) canine cases and 65 (58.0%) of feline cases were collected.

Therefore, the SAC, UVH should definitely increase the number of AVO's available to further improve case numbers (Table 7).

Table 7: Number of AVO's available versus number of cases at the front office during the study period

	AVO			Total
	1	2	4	
Canine	1	2	47	50
Feline	9	2	65	76
Total	10	4	112	126

4.1.2.3 Number of AVO's at the Dispensary

The same correlational relationship was also observed for the dispensary ($r=0.981$, $p<0.05$). This perhaps is one of the factors that contributed to this station having among the shortest turnaround time recorded for the current study. Least number of cases was recorded when there was only 1 AVO at the dispensary, and there were 2 (23.1%) canine and 10 (76.9%) feline cases. When there were 2 AVO in dispensary, 18 (52.9%) canine and 16 feline (47.1%) were collected respectively. In case of 3 AVO, 29 (36.7%) canine cases and 50 (63.3%) feline cases were collected (Table 8).

Table 8: Number of dispensary staffs available versus number of cases at the front office during the study period

	Dispensary			Total
	1	2	3	
Canine	3	18	29	50
Feline	10	16	50	76
Total	13	34	79	126

4.1.2.4 Number of Receptionist

Similarly, the number of receptionists on duty is positively correlated ($r=0.885$, $r<0.05$) with the number of cases recorded. When there were 2 receptionists, 1 (11.1%) canine cases and 8 (88.9%) feline cases were collected. Only feline cases were collected when there were 4 receptionists, which were 9 cases. 17 (32.1%)

canine cases and 36 (67.9%) feline cases were collected when there were 5 receptionists. Most cases were collected when there were 6 receptionists; there were 32 (58.2%) canine cases and 23 (41.8%) feline cases (Table 9).

Table 9: Number of receptionists available versus number of cases at the front office during the study period

	Receptionist				Total
	2	4	5	6	
Canine	1	0	17	32	50
Feline	8	9	36	23	76
Total	9	9	53	55	126

4.1.2.5 Number of VO and Number of AVO Involved in One Consultation

All cases involved only 1 VO. However, there were 31 cases which were not assisted by AVO, 18 (58.1%) of them were canine cases while 13 (41.9%) were feline cases. It was also found that most cases were assisted by one AVO's comprising of 29 (33.3%) canine and 58 (66.7%) feline cases. It is quite rare to have 2 AVO's assisting the same cases, of which this study only recorded 3 (37.5%) canine and 5 (62.5 %) feline cases (Table 10).

Table 10: Number of AVO involved versus number of cases at the front office during the study period

	AVO Involved in One Consultation			Total
	0	1	2	
Canine	18	29	3	50
Feline	13	58	5	76
Total	31	87	8	126

4.2 Turnaround Time (TAT) for All Service Stations

4.2.1 Overall Descriptive Statistics

Not all cases recorded in this study went through all the service stations. For station 3, station 4, station 5, and station 8, only a certain number of cases went through these stations, but not all. The overall descriptive statistics of TAT for all service

stations are shown in Table 11. All the TAT data are tabulated corresponding to all the factors, except for the number of VO involved in one consultation, because all cases collected were attended by one VO only (Appendix XI to Appendix XXII).

The mean TAT for station 1 was found to be the longest compared to other service stations, which was 42.10 minutes. The second longest was recorded at radiology unit (station 4). Shortest TAT was at the dispensary station (station 8).

Table 11: Overall TAT (in minutes) description for all service stations

Station	1	2	3	4	5	6	7	8	Total time
Mean	42.08	16.06	8.39	26.74	9.34	10.93	15.81	1.96	103.45
SE	2.57	0.92	1.09	2.40	1.11	0.88	0.96	0.15	3.67
Median	30.00	14.00	7.00	22.00	6.00	8.00	12.50	2.00	98.50
Mode	14.00	14.00	4.00	22.00	2.00	8.00	9.00	2.00	98.00
SD	28.82	10.29	5.25	14.21	10.97	9.84	10.79	1.30	41.17
Variance	830.84	105.84	27.52	201.90	120.44	96.90	116.51	1.68	1695.05
Range	106.00	50.00	18.00	61.00	62.00	53.00	76.00	6.00	208.00
Minimum	2.00	1.00	2.00	10.00	0.00	0.00	1.00	1.00	23.00
Maximum	108.00	51.00	20.00	71.00	62.00	53.00	77.00	7.00	231.00

4.2.2 Interval to Total Turnaround Time Ratio (IR)

IR is expressed as the percentage of the TAT of a particular service station over the total TAT. IR is capable of showing the impact of each TAT in a specific service station. Thus, a longer TAT of a specific service station will have a larger ratio, which indicates the greater the magnitude is.

Clients commonly spent near 40% of the total time waiting at the reception area. If they are to going radiology unit, about 22% of the total time will be spent there. The amount of station 2 and station 7 was almost similar, which were 17.60% and 16.60%.

4.3 Factors Affecting Turnaround Time (TAT)

Almost all TATs for all service stations are different. Certain factors may only have influence on the TAT on specific service stations; however, they can be confounded by other factors. More details on factors influencing TATs for different service stations will be discussed further in discussion later. Not all the factors were found to be significantly affecting the TATs at specific service stations in this study.

4.3.1 Attributes of Cases

4.3.1.1 Days

Wednesday had significantly longer TAT for station 1 (mean = 54.24 mins) compared to Thursdays (mean = 34.40), Fridays (mean = 13.67 mins), and Saturdays (mean = 14.56 mins). Incidentally, these are also the days when the SAC had its highest number of daily cases. All these suggested that there were significant waiting time for the clients at the reception before they proceed to the station 2 for consultation and treatments.

TAT for station 5 on Mondays (mean = 18.17 mins) was also significantly longer compared to Tuesday (mean = 6.67 mins), Wednesday (mean = 11.04 mins), Thursday (mean = 9.19 mins), Friday (mean = 4.33 mins), and Saturday (mean = 2.22 mins. Wednesday also recorded longer TAT for station 5 which was significantly longer compared to Saturday (p<0.05).

It also interesting to note that the time spent at the payment process (station 7) was also quite significant. TAT for station 7 on Mondays (mean = 27.25 mins) was also longer than Tuesday (mean = 13.21 mins), Wednesday (mean = 14.49 mins), Thursday (mean = 16.10 mins), Friday (mean = 9.67 mins), and Saturday (mean = 12.11 mins) (p<0.05) Thursday was also having longer station 7 compared to

Tuesday and Friday (p<0.05) It is interesting to note that the busier days had significantly shorter TAT for station 7 compared to those from Mondays, which is a relatively quiet day at the SAC.

Total time spent on the entire consultation process on per case basis (total time) was much shorter on Saturdays (mean = 55.00 mins) compared to Mondays (mean = 133.50 mins), Tuesdays (mean = 101.89 mins), Wednesdays (mean = 112.73 mins) and Thursdays (mean = 100.73 mins). Fridays also had shorter Total time compared to Mondays and Wednesdays (Table 11).

Table 12: TAT (in minutes) across days of the week

Station	1	2	3	4	5	6	7	8	Total time
	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Mon	46.25	13.87	13.00	37.57	18.17	9.50	27.25	1.60	133.50
Tue	46.79	17.25	5.00	21.33	6.67	9.43	13.21	1.38	101.89
Wed	54.24	14.11	6.00	21.50	11.04	13.32	14.49	2.46	112.73
Thu	34.40	18.73	11.67	27.27	9.19	11.13	16.10	2.05	100.73
Fri	13.67	13.67	10.00	30.00	4.33	10.67	9.67	1.50	59.67
Sat	14.56	17.00	.	.	2.22	7.78	12.11	1.71	55.00

4.3.1.2 Species Difference

Station 3 for canine cases (mean = 12.33 mins) was significantly longer than feline cases (mean = 5.86 mins) with p value less 0.05.

Station 5 is also significantly longer for canine cases (mean = 11.31 mins) compared to that of feline cases (mean = 8.18 mins) with p value less than 0.05 (Table 12).

Table 13: TAT (in minutes) across species

Station	1	2	3	4	5	6	7	8	Total time
	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Canine	44.46	17.48	12.33	25.73	11.31	13.56	14.04	2.35	109.50
Feline	40.51	15.13	5.86	27.50	8.18	9.20	16.97	1.71	99.47

4.3.1.3 Type of Cases

Outpatient cases had a shorter time TAT for station 5 (mean = 8.27 min) compared to inpatient cases (mean = 16.23 mins) at $p < 0.05$. Based on Mann Whitney U test, the TAT for station 6 for inpatient cases (mean = 3.20 min) was also significantly shorter than outpatient (mean = 12.84 mins) with a p value < 0.05 (Table 13).

Table 14: TAT (in minutes) across types of cases

Station	1	2	3	4	5	6	7	8	Total time
	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Inpatient	42.56	18.48	20.00	26.30	16.23	3.20	11.96	.	95.96
Outpatient	41.96	15.47	7.86	26.92	8.27	12.84	16.76	1.96	105.31

4.3.1.4 Complexities and Procedural Differences

Health care cases had significantly shorter TAT (mean = 24.21 mins) than surgery (mean = 47.92 mins), medicine (mean = 53.52 mins), and check up cases (mean = 42.93). Medicine cases had significantly longer TAT at the reception than revisit cases (mean = 30.69 mins).

Complexity of cases did affect the TAT time at station 5. Kruskal-Wallis Test (KWT) revealed there was a significant difference for different complexity of cases at $p< 0.05$. Multiple Mann-Whitney U Tests (MWUT) showed that surgery cases (mean = 22.57 mins) had longer TAT for station 5 compared to medicine (mean = 10.39 mins), health care (mean = 3.61 mins), and revisit cases (mean = 9.70 mins). Medicine and health care cases were also significantly different in their Station 5. Health care cases had significantly ($p<0.05$) shorter station 5 than revisit and check up cases. Correspondingly, healthcare cases also had significantly shorter total time (mean = 73.93 mins) compared to cases like surgery (mean = 119.75 mins),

medicine (mean = 110.78 mins), and check up cases (mean = 124.47 mins), as shown in Table 14.

Table 15: TAT (in minutes) across different complexities of cases

Station	1	2	3	4	5	6	7	8	Total time
	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Surgery	47.92	18.08	19.00	24.60	22.57	7.92	16.00	1.60	119.75
Medicine	53.52	14.09	8.64	29.62	10.39	10.67	14.00	1.76	110.78
Healthcare	24.21	14.69	6.50	21.20	3.61	11.03	15.24	2.62	73.93
Revisit	30.69	17.94	7.00	22.83	9.70	14.69	19.31	2.33	100.31
Checkup	42.93	22.20	6.33	30.83	11.27	10.07	19.53	1.64	124.47

4.3.1.5 Group Visit versus Individual Visits

For individual patients, the station 1 (mean = 44.14 mins) was significantly longer (p<0.05) than group visit patients (mean = 35.50 mins). Station 5 for individual patients (mean = 11.37 mins) was also longer than group visit cases (mean = 3.81 mins), as shown in Table 15.

Table 16: TAT (in minutes) across types of cases

Station	1	2	3	4	5	6	7	8	Total time
	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Individual	44.14	14.43	8.43	28.00	11.37	9.11	15.34	1.73	102.47
Group	35.50	21.30	8.00	22.50	3.81	16.73	17.30	2.52	106.60

4.3.1.6 Appointment

It is noted that making appointment prior to visits shortens the time spent at station 1 (station 1). The station 1 for appointment cases (mean = 24.50 mins) was significantly (p<0.05) shorter than walk in cases (mean = 48.58 mins). Station 5 for walk in cases (mean = 10.81 mins) was longer than appointment cases (mean = 5.90 mins), Walk in cases also had significantly longer total time (mean = 111.12 mins) than appointment cases (mean = 82.71 mins) (p<0.05).

Table 17: TAT (in minutes) across types of appointments

Station	1	2	3	4	5	6	7	8	Total time
	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Walk in	48.58	15.89	8.57	28.04	10.81	9.89	15.84	1.75	111.12
Appointment	24.50	16.53	6.50	22.37	5.90	13.74	15.74	2.60	82.71

4.3.1.7 Sessions

Cases in afternoon session had significantly longer station 1 (mean = 65.06 mins) and total time (mean = 127.24 mins) than cases which came in during morning session (station 1: mean = 33.59 mins, total time: mean = 94.66 mins).

Table 18: TAT (in minutes) across time of visit

Station	1	2	3	4	5	6	7	8	Total time
	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Morning	33.59	15.13	9.12	27.46	9.03	10.90	17.32	1.98	94.66
Afternoon	65.06	18.59	6.33	24.67	10.11	11.00	11.74	1.92	127.24

4.3.2 Human Resources

4.3.2.1 Number of Veterinary Officers (VO's)

The number of VO avaibale had significant effect on station 1 and total time. When only 3 VO's were available, Time 1 was 59.65 mins which was significantly longer than the station 1 recorded when 5 VO's were available at 32.10 mins). The total time spent at the clinic for the average client was also significantly shorter at 95.68 mins when there were 5 VO's available, as compared to when there were only 3 VO's (mean = 122.46 mins). This represents a time difference of about 20 %.

Interestingly, the total time when there was 1 VO (mean = 55.00 mins) was significantly shorter than when there was 3 VO (mean = 122.46 mins), 4 VO (mean = 107.89 mins), 5 VO (mean = 95.68 mins), and 6 VO (mean = 109.13 mins). This is

easily explainable as 1 veterinary officer were typically available during the quieter times of the week or day, hence the shorter total time recorded.

Table 19: TAT (in minutes) across number of VO's available

Station	1	2	3	4	5	6	7	8	Total time
	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
1	14.56	17.00	.	.	2.22	7.78	12.11	1.71	55.00
3	59.65	13.69	6.60	21.67	12.70	15.04	14.69	2.68	122.46
4	53.11	18.47	5.00	23.00	4.83	10.79	10.74	1.73	107.89
5	32.10	15.27	8.50	31.42	8.44	10.17	19.85	1.67	95.68
6	41.77	17.35	11.00	26.82	12.67	9.48	15.58	1.81	109.13

4.3.2.2 Number of Assistant Veterinary Officers (AVO's)

It was observed that station 1 was significantly longer when there were 4 AVOs (mean = 45.33 mins) compared to when there was only 2 (mean = 14.75 mins) and 1 AVO (mean = 16.60 mins). When there was 1 AVO, station 5 (mean = 2.90 mins) was significantly shorter than when there was 4 AVOs (mean = 10.34 mins). Total time was significantly longer when there was 4 AVOs (mean = 108.71) compared to when there was 1 AVO (mean = 59.50 mins). These findings are quite consistent with the trends observed for the number of VO's in the prior section (Table19).

Table 20: TAT (in minutes) across number of AVO's available

Station	1	2	3	4	5	6	7	8	Total time
	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
1	16.60	16.90	.	22.00	2.90	7.80	11.80	1.63	59.50
2	14.75	15.25	10.00	30.00	4.75	11.25	9.75	1.00	66.25
4	45.33	16.02	8.32	26.79	10.34	11.20	16.38	2.03	108.71

4.3.2.3 Number of AVO at the Dispensary

Number of AVO in dispensary was also found to affect station 1. When there were 3 AVOs in dispensary, station 1 (mean = 40.94 mins) was significantly shorter than when there was 2 AVOs (mean = 55.24 mins) in the dispensary. When there was 1

AVO in the dispensary, station 1 (mean = 14.62 mins) was even shorter compare to when there were 2 and 3 AVOs. These are further testament to the increased efficiency of the dispensary section with added number of functioning staffs (Table 20).

Table 21: TAT (in minutes) across number of staffs available at the dispensary

Station	1	2	3	4	5	6	7	8	Total time
	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
1	14.62	16.46	10.00	30.00	3.00	8.85	11.38	1.56	58.46
2	55.24	13.74	12.00	20.50	15.04	14.26	14.94	2.50	121.91
3	40.94	17.00	7.24	30.00	8.21	9.84	16.91	1.76	102.91

4.3.2.4 Number of AVO Involved in One Consultation

When there was no AVO assisting the consultation, station 3 (mean = 12.43 mins) was significantly longer compared to when there was 1 AVO assisting (mean = 6.79 mins). This was quite consistent with the situation where cases that required the involvement of more AVO's were typically cases that were complex (Table 21).

Table 22: TAT (in minutes) across number of AVO's involved in one consultation

Station	1	2	3	4	5	6	7	8	Total time
	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
0	38.35	16.26	12.43	20.29	11.04	9.90	14.74	2.07	97.74
1	42.53	16.49	6.79	28.92	8.25	11.46	15.82	1.97	104.44
2	51.62	10.63	5.50	23.67	14.14	9.13	19.88	1.60	114.88

4.4 Revenue

The average revenue per cases for the duration of the study is RM 166.10 per case, with highest on Monday (RM 194.23) and lowest on Saturday (RM 77.99). The man-hour per case for VO was 0.98 man-hour per case, whereas for AVO was 1.01 man-hr per case. The wage input per case was RM 23.50 for VO and RM 14.00 for

AVO. Thus, the wage input of VO and AVO per case was RM 37.50. Therefore, in order to achieve maximum profitability based on current estimates of human resource inputs, while keeping out fixed costs constant, this is translated to a input cost to output cost ratio of 0.2257 [(RM14+RM23.5)/RM166.10].

5.0 DISCUSSION

In this study, the factors which were affecting the TAT for different service stations can be categorized into two broad groups, which are the nature of cases and human resources' factors. Not all the factors affected the TAT of each service station significantly. Most factors were found to have an effect on station 1 and station 5.

As shown in the result, station 1 was longer during the earlier part of the week. On Fridays and Saturdays, station 1 was shorter compared to other days. This is because on Fridays the reception for cases was only until 12.00pm, thus, no lunch hour in between the morning and afternoon sessions. Therefore, the TAT for reception was shorter. On Saturdays, all cases attended were healthcare cases, thus, station 1 was also relatively shorter. On Saturday, all the service stations were typically shorter, because of the complexity of the cases.

Canine species had longer station 3 compared to feline species because some of the cases were more complex, thus more time is needed to spend in the minilab, such as oncology cases and also skin diseases. These cases typically need more time in minilab for microscopic examination.

Compare to inpatient cases, outpatient cases needed less time for station 5, simply because inpatient cases are more complicated, more discussions need to be done with the clients. For surgery inpatient cases, the risk, cost, and plan of the surgery are required to be discussed with the clients as well. The schedule of the surgery also needs to be confirmed before the time of the surgery can be arranged. Quotation of the inpatient cases are sent to the reception counter almost immediately after clients left. Therefore for inpatient cases, station 6 is very short compared to outpatient cases.

Station 1 was observed to be increased as the complexity of the cases increased. Healthcare cases recorded the shortest TAT compared to other categories, such as medicine cases, surgery cases, and so on. The reason is because less complex cases are typically consulted first in the small animal clinic, if the queue number is reasonably close. For complex cases, station 5 was longer as well, for examples for surgery and medicine cases.

Individual visits had longer station 1 and station 5 compared to group visits. This is because most of the time, individual visits are more complicated cases, whereas group visits are typically feline cases which are healthcare cases and also feline upper respiratory disease.

Compared to walk-in cases, appointment cases had shorter station 1 because appointment cases are given priority for the consultation. Also, the patient files and document are prepared beforehand.

Cases logged during the afternoon session had longer waiting time at the reception simply because of the lunch hour that they went through during the process of waiting. During lunch time, the number of VO and AVO available were reduced, thus the TAT was prolonged. This therefore pointed to a potential area of improvement for the SAC, UVH in case scheduling and staff member deployment during lunch hours that would significantly reduce waiting time for clients at the reception counter.

The number of VO's available at the SAC was also found to affect TAT for station 1 significantly. Station 1 decreased as the number of VO increased. However, allocation of human resources may not guarantee a shorter TAT, and this is because the TAT can be affected by many other factors, such as the complexity of cases,

availability of the consultation room, among others. On the contrary, higher number of AVO's at the dispensary did result in shorter station 1. The reason is that by allocating more AVO in the dispensary, they able to speed up the documentation, billing, and dispensing processes. Thus, VO will be available to consult the next case in line. It was also found that it is possible to record the shortest time at the reception station with only 1 VO available. However, this only occurred on Saturdays when only health care cases were consulted. However, it should be noted that these type of scenario is not typical of cases consulted at the SAC, UVH on a day to day basis.

The current study also found that when station 1 is significantly prolonged, the total time will be prolonged as well, this is because about 40% of the total time was station 1. This in itself is a potential area for the SAC, UVH to improve upon, as cutting down the waiting time a reception not only improves the work flow efficiency, but also represent a major customer service improvement and perception to the clients.

There are many other factors which can affect the TAT at SAC, UVH. Among them is the availability of the consultation rooms. Sometimes, procedures such as treatment is carried out in the consultation room, which makes the room temporary unavailable to the next consultation. Quarantine protocols of several infectious disease will also render the consultation room unavailable, this as well indirectly increase the TAT.

Secondly is the layout of the hospital. For example, although there are very clear instruction and guide from the consultation room to the radiology unit, clients will still get confused when they are searching for it. This can contribute to prolong the TAT as there will be a delay for the client to transit from one service station to the

next service station. The fact that UVH is a teaching hospital also plays a significant in prolonging TAT for select cases that were being used as teaching materials. Sometimes, involvement of students might slow down the consultation process. Lastly, teamwork of VO and AVO and also inter-process coordination are also important when it comes to TAT. Good teamwork and coordination also can help to shorten the TAT at the SAC.

This study actually identified potential "choke points" that degrade the visit experiences of clients at the SAC, UVH. The waiting time that the clients had gone through can actually induce dissatisfaction of clients. The TAT is depending on the deployment of staff and also the nature of cases. It is best to utilize the station for nothing but its original purpose.

Several recommendations are available to improve the service efficiency at the SAC, UVH. The TAT can actually improve quickly by minimizing the waiting at the counter, both for consultation and also payment. TAT can also be improved by rationally deploying staff to when and where they are needed the most, as the data on the number of staff available versus the reducing TAT showed. Computerized case management system could be an immediate solution to speed up the TAT. This is because all the paperwork can be recorded in computer system, thereby reducing large amount of time at the registration counter at the reception.

6.0 CONCLUSIONS

In conclusion this study showed that the TAT at the SAC, UVH are influence by the availability of staff members and inherent attributes of each cases. These in turn affect the TAT recorded for each station and their variability across time of the week and day. A significant amount of time spend by the clients was recorded at three service stations which were reception, consultation and during payment. Along with the time spent at radiology station, these four key processes were responsible for almost 80% of the time spent by clients at the SAC, UVH. These findings further highlighted the need for the SAC, UVH to rethink staff deployment and associated ancillary processes to further improve workflow efficiencies at the SAC, UVH.

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