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Queuing Problems in Pharmacies within the South African Public Health Care Sector

By

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A research report submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Business Administration.

Johannesburg, August 2009

DECLARATION

I, Zuleika Goolam Rhemtula, declare that this research report is my own, unaided work, except as indicated in the acknowledgements, the text and the references. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the University of the Witwatersrand, Johannesburg. It has not been submitted before either in whole or in part, for any degree or examination at this or any other university.

_____

Zuleika Goolam Rhemtula

Signed at ……

on the …….. day of ……. 2009

DEDICATION

In memory of my Dad: Thank you for encouragement that led me to my MBA studies

To Mom, Sisters and their families: Thank you for your unconditional love, support and assistance during my studies

ACKNOWLEDGEMENTS

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Your direct and indirect inputs into this research project are greatly appreciated

ABSTRACT

This research report investigated demand and supply factors affecting pharmaceutical services and assisted with making recommendations to the Steve Biko Academic Hospital management on how to reduce the mean waiting times and to improve the actual and perceived customer services at the SBAH outpatient pharmacy.

The demand and supply of pharmaceutical services was investigated through a quantitative methodology, using data collection forms to quantify the factors affecting queues at the Steve Biko Academic Hospital outpatient pharmacy. The qualitative methodology observed the layout, processes and the attitude of staff, using an unstructured observation checklist; with the intention of providing clarity and explanation for the quantitative findings of this research.

The findings of this research will serve as historical standards or baseline measures against which future performance can be measured. The recommendations to improve the waiting time at the Steve Biko Academic Hospital's out patient pharmacy were categorised into infrastructure, demand management and supply management recommendations. The infrastructure and supply management recommendations will improve efficiencies within the outpatient pharmacy however, the implementation of the demand management strategies will provide a greater impact on the waiting times of the patients at the Steve Biko academic hospital's out patient pharmacy.

TABLE OF CONTENTS

DECLARATION II
ACKNOWLEDGEMENTS IV
ABSTRACT V
TABLE OF CONTENTS VI
LIST OF TABLES XI
LIST OF FIGURES XIII
LIST OF ABBREVIATIONS XIV

CHAPTER 1: INTRODUCTION 1

1.1 THE PURPOSE OF THE RESEARCH 2
1.2 THE CONTEXT OF THE RESEARCH 3
1.3 THE OBJECTIVE OF THE RESEARCH 4
1.4 SIGNIFICANCE OF THE RESEARCH 5
1.5 DELIMITATION AND LIMITATION OF THE RESEARCH 6
1.5.1 DELIMITATIONS 6
1.5.2 LIMITATIONS 6
1.6 ASSUMPTIONS 7

CHAPTER 2: LITERATURE REVIEW 9

2.1 UNDERSTANDING WAITING TIMES, WAITING TIME GUARANTEES AND PATIENT SATISFACTION 10
2.2 THE DEMAND FOR PHARMACEUTICAL SERVICES 14
2.2.1 THE ARRIVAL RATE OF PRESCRIPTIONS 14
2.2.2 RATIONAL DRUG PRESCRIBING 15
2.2.3 PACKING OF MEDICATION DURING THE DISPENSING PROCESS 18
2.2.4 AVAILABILITY OF MEDICATION 19
2.3 THE SUPPLY OF PHARMACEUTICAL SERVICES 21
2.3.1 STAFF AVAILABILITY 21

2.3.2 COMPETENCY OF PHARMACIST ASSISTANTS 23
2.4 OBSERVING WORKFLOWS, BOTTLENECKS AND OTHER FACTORS AFFECTING THE DISPENSING PROCESS 26
2.5 LITERATURE REVIEW SUMMARY 27

CHAPTER 3: RESEARCH METHODOLOGY 30

3.1 THE QUANTITATIVE DATA COLLECTION 30
3.2 QUALITATIVE DATA COLLECTION 34
3.3 RESEARCH APPROVAL 34
3.4 THE STUDY POPULATION 35
3.5 SAMPLING METHODOLOGY 35
3.6 BRIEFING SESSION AND A PILOT PROJECT 36
3.7 DATA ANALYSIS 37
3.8 VALIDITY AND RELIABILITY 38

CHAPTER 4: CASE MOTIVATION 39

CHAPTER 5: PRESENTATION OF THE RESULTS 43

5.1 DOCUMENT RECONCILIATION 43
5.2 RESULTS PERTAINING TO OBJECTIVE 1: TO COMPARE AND VALIDATE THE GDH AVERAGE WAITING TIME WITH THE AVERAGE WAITING TIME FROM THE RESEARCH 44
5.2.1 THE AVERAGE WAITING TIMES FOR THE PATIENTS AT THE SBAH OUTPATIENT PHARMACY 44
5.3 RESULTS PERTAINING TO OBJECTIVE 2: TO DETERMINE THE AVERAGE ARRIVAL RATE AND THE INTER-ARRIVAL DISTRIBUTION FOR THE PRESCRIPTIONS AT THE SBAH OUTPATIENT PHARMACY 50
5.4 RESULTS PERTAINING TO OBJECTIVE 3: TO DETERMINE THE AVERAGE NUMBER OF ACUTE, CHRONIC AND PRIORITY PRESCRIPTIONS SEEN AT THE SBAH OUTPATIENT PHARMACY 54
5.5 RESULTS PERTAINING TO OBJECTIVE 4: TO DETERMINE THE AVERAGE NUMBER OF LINE ITEMS PRESCRIBED PER PRESCRIPTION AT THE SBAH 61

5.6 RESULTS PERTAINING TO OBJECTIVE 5: TO THEORETICALLY DETERMINE THE NUMBER OF PRESCRIPTIONS THAT COULD BE DOWN REFERRED TO THE PRIMARY LEVEL OF CARE FOR CLINICAL MANAGEMENT. 64
5.7 RESULTS PERTAINING TO OBJECTIVE 6: TO DETERMINE THE AVERAGE NUMBER OF MEDICATIONS REQUIRING PACKING AND THE ADDITIONAL TIME REQUIRED TO PACK AN ITEM DURING THE DISPENSING PROCESS AT THE SBAH OUTPATIENT PHARMACY 65
5.8 RESULTS PERTAINING TO OBJECTIVE 7: TO DETERMINE THE NUMBER OF PRESCRIPTIONS WITH AN ITEM OUT OF STOCK AND THE ADDITIONAL TIME REQUIRED TO MANAGE AN OUT OF STOCK SITUATION AT THE SBAH OUTPATIENT PHARMACY 67
5.9 RESULTS PERTAINING TO OBJECTIVE 8: TO DETERMINE THE SERVICE RATE, THE SERVICE DISTRIBUTION AND THE AVERAGE NUMBER OF SERVERS SERVING THE PATIENTS AT THE SBAH OUTPATIENT PHARMACY 69
5.10 RESULTS PERTAINING TO OBJECTIVE 9: TO DETERMINE THE AVERAGE NUMBER OF ERRORS MADE DURING THE DISPENSING PROCESS AND THE ADDITIONAL TIME REQUIRED TO RECTIFY AN ERROR AT THE SBAH OUTPATIENT PHARMACY 74
5.11 RESULTS PERTAINING TO OBJECTIVE 10: TO OBSERVE THE WORKFLOW, LAYOUT, ATTITUDE OF STAFF AND OTHER INTERRUPTIONS AFFECTING THE SUPPLY OF PHARMACEUTICAL SERVICES AT THE SBAH OUTPATIENT PHARMACY 76
5.11.1 ATTITUDE OF STAFF 79
5.11.2 PROCUREMENT OF STOCK FROM THE PHARMACY STORES 80
5.11.3 OTHER OBSERVATIONS 80

CHAPTER 6: DISCUSSION OF THE RESULTS 81

6.1 OBJECTIVE 1: TO COMPARE AND VALIDATE THE GDH AVERAGE WAITING TIME WITH THE AVERAGE WAITING TIME FROM THE RESEARCH 81
6.2 OBJECTIVE 2: TO DETERMINE THE AVERAGE ARRIVAL RATE AND THE INTER-ARRIVAL DISTRIBUTION FOR THE PRESCRIPTIONS AT THE SBAH OUTPATIENT PHARMACY 86
6.3 OBJECTIVE 3: TO DETERMINE THE AVERAGE NUMBER OF ACUTE, CHRONIC AND PRIORITY PRESCRIPTIONS SEEN AT THE SBAH OUTPATIENT PHARMACY THROUGHOUT THE DAY 92
6.4 OBJECTIVE 4: TO DETERMINE THE AVERAGE NUMBER OF LINE ITEMS PRESCRIBED PER PRESCRIPTION AT THE SBAH 96

6.5 OBJECTIVE 5: TO THEORETICALLY DETERMINE THE NUMBER OF PRESCRIPTIONS THAT COULD BE DOWN REFERRED TO THE PRIMARY LEVEL OF CARE FOR CLINICAL MANAGEMENT. 98
6.6 OBJECTIVE 6: TO DETERMINE THE AVERAGE NUMBER OF MEDICATIONS REQUIRING PACKING AND THE ADDITIONAL TIME REQUIRED TO PACK AN ITEM DURING THE DISPENSING PROCESS AT THE SBAH OUTPATIENT PHARMACY 99
6.7 OBJECTIVE 7: TO DETERMINE THE NUMBER OF PRESCRIPTIONS WITH AN ITEM OUT OF STOCK AND THE ADDITIONAL TIME REQUIRED TO MANAGE AN OUT OF STOCK SITUATION AT THE SBAH OUTPATIENT PHARMACY 100
6.8 OBJECTIVE 8: TO DETERMINE THE SERVICE RATE, THE SERVICE DISTRIBUTION AND THE AVERAGE NUMBER OF SERVERS SERVING THE PATIENTS AT THE OUTPATIENT PHARMACY 101
6.9 OBJECTIVE 9: TO DETERMINE THE AVERAGE NUMBER OF ERRORS MADE DURING THE DISPENSING PROCESS AND THE ADDITIONAL TIME REQUIRED TO RECTIFY AN ERROR AT THE SBAH OUTPATIENT PHARMACY 108
6.10 FINDINGS SUPPORTING OBJECTIVE 10: TO OBSERVE THE WORKFLOW, LAYOUT, ATTITUDE OF STAFF AND OTHER INTERRUPTIONS AFFECTING THE SUPPLY OF PHARMACEUTICAL SERVICES AT THE SBAH OUTPATIENT PHARMACY 111

CHAPTER 7: CONCLUSION AND RECOMMENDATIONS 113

7.1 RECOMMENDATIONS 117
7.2 SUGGESTION FOR FUTURE RESEARCH 121

CHAPTER 8: REFERENCES 123

CHAPTER 9: ANNEXURE 134

9.1 ANNEXURE 1 134
9.2 ANNEXURE 2: 135
9.3 ANNEXURE 3 136
9.4 ANNEXURE 4 137
9.5 ANNEXURE 5 138
9.6 ANNEXURE 6 139
9.7 ANNEXURE 7 140

9.8 ANNEXURE 8 141

LIST OF TABLES

Table 1: The average benchmark and the waiting times for the four academic hospitals .. 13
Table 2: Document reconciliation 43
Table 3: The average waiting time for the SBAH outpatient pharmacy 45
Table 4: The number of prescriptions that waited longer than the waiting time benchmark 46
Table 5: The secondary waiting and service times for the sample population 47
Table 6: The average arrival rate of acute, repeat and all prescriptions 52
Table 7: The inter-arrival times of prescriptions 53
Table 8: The activity mix of prescriptions 55
Table 9: The activity mix of prescriptions including the priority prescriptions 55
Table 10: The average arrival of priority prescriptions 56
Table 11: The number of prescriptions per priority category 58
Table 12: Secondary waiting and service times for the priority patients 60
Table 13: The average number of line items prescribed per prescription 61
Table 14: The number of prescriptions with the different number of line items prescribed 62
Table 15: The average service time to prepare a line item per prescription 63
Table 16: The number of prescriptions that could be down referred 64
Table 17: The number of prescriptions that cannot be down referred 65
Table 18: Number of items requiring packing during the dispensing process 66
Table 19: The average additional time required to pack an item during the dispensing process 67
Table 20: The number of items out of stock 68
Table 21: The average additional time required to manage an item out of stock 68
Table 22: The number of staff members involved in the dispensing process 69
Table 23: The staff establishment for the SBAH pharmacy 70
Table 24: Number of prescription being served or waiting to be served 71
Table 25: Average service rate 71
Table 26: The average daily arrival and service rate 72
Table 27: The service time distribution 73

Table 28: The types of errors made during the dispensing process 74
Table 29: The average additional time required to correct an error on the prescriptions ... 75
Table 30: Prescriptions with errors versus the number of line items prescribed 76

LIST OF FIGURES

Figure 1: The relationship between the demand and supply of services and queue 9
Figure 2: Changing mindsets (Cabera 2007)..... 11
Figure 3: Optimal service level (Singh 2006) 20
Figure 4: The quantitative approach to data collection (source: developed by the author) 31
Figure 5: The dispensing process (Source: developed for the research by the author)..... 32
Figure 6: System dynamic model for pharmaceutical service (developed by the author for the research)..... 41
Figure 7: Analysis of the secondary waiting and service times (Developed by the author for the research)..... 48
Figure 8: The waiting times of patients in relation to the waiting time benchmark 81
Figure 9: The relationship between the secondary waiting and service times 84
Figure 10: The inter-arrival distribution..... 87
Figure 11: The average arrival rate of acute prescriptions..... 88
Figure 12: The average arrival rate of repeat prescriptions 89
Figure 13: The average arrival rate for all prescriptions..... 90
Figure 14: The activity mix of prescriptions..... 92
Figure 15: The activity mix including the priority prescription..... 93
Figure 16: The arrival of priority patients..... 94
Figure 17: The arrival versus the service rate 102
Figure 18: The service distribution 107
Figure 19: The Number of line items prescribed versus the number of errors made..... 110

LIST OF ABBREVIATIONS

Terms	Meaning	Reference Source
DCCS	Directorate of Clinical Support Services	DCCS 2007
DOH	Department of Health which is the same as the National Department of Health (NDH)	
Fri	Friday	
GDH	Gauteng Department of Health	GDH 2006/7 GDH 2007/8)
HST	Health Systems Trust	HST 2002 HST 2003/4 HST 2007
IHI	Institute of Healthcare Improvements	IHI 2008
Mon	Monday	
MSH	Management Sciences for Health	MSH 1997
NDH	National Department of Health	NDH 2006
PHWSBC	Public Health and Welfare Sector Bargaining Council	PHWSCB 2004
RSA	Republic of South Africa	RSA 1997
SAPH	Society of Hospital Pharmacist of Australia	SAPH 2004
Thurs	Thursday	
Tue	Tuesday	
UCH	University Health Systems Consortium	UCH 2005
UNCHR	United Nation High Commission For refugee	UNCHR 2006
Wed	Wednesday	

CHAPTER 1: INTRODUCTION

Queuing is a part of everyday life and waiting can be frustrating, annoying, time-wasting and costly (Maister 1985, Hillier and Hillier 2003). Waiting for services has become an increasingly common problem in many commercial situations. People can wait either before, during or after a service and the wait can last minutes, hours or even days (Taylor 1994). People waiting clearly understand that "one's most precious resource, time, a fraction of one's life, is irrecoverably lost" (Taylor 1994). Often the cost of waiting to the patient is the disproportionately long wait, measured in hours, compared to the actual service time, usually measured in minutes (Bailey 1952).

A long waiting time within the public health care sector is often perceived to be a chronic state instead of a temporary acute problem (Brailsford *et al.* 2004) and has the reputation for being excessive. Long waiting times significantly affects the overall perception of the quality of the service provided, irrespective of the fact that the actual transaction was efficient, courteous and complete (Maister 1985). Waiting time, a major component of patient satisfaction (Eilers 2004) has gained popularity as an indicator for determining the quality of service delivered.

One of the Gauteng Department of Health (GDH) strategic goals is to provide caring, responsive and quality health care services throughout the province (GDH 2007) and the department uses the mean waiting time as a measure of service delivery. Addressing long waiting times within the public health care facilities is now a requirement of all departments and this is intended to improve both patient and staff perceptions about the services provided. Health care providers within the public health care sector pharmacies now face a common challenge of identifying and understanding the effects of underlying factors affecting demand and supply of pharmaceutical services, before allocating resources and streamlining processes to meet the demands made by the patients (University Health Systems Consortium (UCH) 2005).

The intended outcome of this exploratory research was to have an improved understanding of how pharmaceutical demand and supply factors impact on the waiting time of patients at the Steve Biko Academic Hospital's (SBAH) outpatient pharmacy, and to make appropriate recommendations to the management of the SBAH to improve the actual and perceived waiting times.

1.1 The purpose of the research

The purpose of the research was to explore, quantify and explain demand and supply factors affecting pharmaceutical services at the SBAH outpatient pharmacy and to gain an improved understanding of how the demand for and the supply of pharmaceutical services directly or indirectly impacts the waiting times of patients within the public health care sector. Queuing problems in any situation is a function of the demand for services and the supply of services to meet the demand.

The mean waiting time computed during this research was also used to validate the mean waiting times routinely recorded by the Quality Assurance Department at the SBAH. The validation of the routine mean waiting time data recorded by the Quality Assurance Department was of critical importance to ensure confidence in the current system employed.

The case methodology used, provided the pharmacy manager at the SBAH out patient pharmacy with a valuable tool to measure baseline information against which all future impact of change can be monitored. Understanding the effect of the different demand and supply factors affecting the current queues within the public sector, assisted with the recommendations made for the future allocation of resources and streamlining of processes for more effective and/or efficient service delivery. The findings of this research formed the basis from which valid inferences were made on how to reduce the mean waiting times and to improve the actual or perceived customer services at the SBAH outpatient pharmacy.

1.2 The context of the research

Crowded waiting rooms and long waiting times are undisputedly the inadequacies in the supply of service seeking to meet the demand for that service. However, addressing the disparity between the supply and demand for pharmaceutical services cannot be done using only one queue performance measure namely the mean waiting time. Maister (1985), Backer (2002), Wilson *et al.* (2005) and Kneider (2007) all confirm that allocating scarce resources and streamlining processes usually require the use of many operational measures as critical elements in challenging the assumption of how things are currently done, and in looking for new ways to ensure sustainable improvements are made. The unavailability of some of the baseline supply and demand information within the public health care sector pharmacies, within the GDH, prompted this research.

Allocating resources to meet the demand for services is a capacity planning and controlling function of operational managers. Capacity planning and controlling approaches used for operations which have the ability to store their finished goods and inventory cannot be applied to service orientated operations wherein the inventory cannot be prepared and stored in advance (Pycraft *et al.* 2004). In such instances queuing theory is the best analytical tool for capacity planning and controlling (Pycraft *et al.* 2004). The factors affecting queues at the pharmacies within the public health care sector were therefore, explored using the basics of queue theory together with the pharmacy specific factors affecting waiting times, as identified in the literature.

The case methodology was considered to be the most appropriate methodology to use as it allowed for:

- A holistic and in-depth investigation from a pharmacy perspective (Tellis 1997).
- The description of a real life situation (Tellis 1997).
- The exploration and the explanation of the causal links between factors fundamental to the system under investigation (Tellis 1997).
- The selection of an appropriate size sample to maximize what could be learned within the shortest time period of the research without too much emphasis on the sampling methodology used (Tellis 1997).

- A greater understanding of actual events occurring within the workplace, with which the broader group of pharmacists could identify even though the applicability of the findings to other sites remains, limited (Tellis 1997).
- The factors considered relevant to the understanding of the case was investigated without any comparison to other theory or templates (Tellis 1997).

The research was conducted at the SBAH outpatient pharmacy which was considered the whole research, where the facts gathered were subsequently used to draw conclusions applicable only to the case site (Tellis 1997).

1.3 The objective of the research

The objective of the research was to explore, quantify and explain demand and supply of pharmaceutical factors which directly or indirectly impact on waiting times of patients at the SBAH outpatient pharmacy.

The research explored the demand for pharmaceutical services by:

- Determining the arrival of prescriptions (Stevenson 1989 and Hillier and Hillier 2003) throughout the day and determining the time of the day when pharmaceutical services were most required.
- Investigating the activity mix of prescriptions (Pycraft *et al.* 2004) seen at the outpatient pharmacy.
- Theoretically determining the appropriate use of tertiary pharmaceutical services (GDH 2007).
- Assessing the rational use of drugs by monitoring the number of line items prescribed per prescription.

The research explored the supply of pharmaceutical services by:

- Assessing the relationship between and within the distinct work processes identified in dispensing a prescription to a patient.
- Determining standard service times for the various stages of the dispensing process.
- Evaluating the competency of pharmacist assistants by monitoring the error rate.
- Evaluating the current capacity planning methodology used for service provision.

An observation of the pharmacy layout and the attitude of staff was conducted to assess the workflow and to identify the most obvious bottlenecks within the pharmacy.

1.4 Significance of the research

This research provided valuable information to the pharmacy manager at the SBAH who could utilise the findings of this report in the process of capacity planning and control, to provide an appropriate level of service with the current available human resource. Although the case findings from the SBAH cannot be generalised to other pharmacies within the GDH, the findings for the SBAH outpatient pharmacy adds to the public sector pharmacy knowledge repository, for future comparative use.

This research provides data on factors affecting queues in pharmacies within the public health care sector in South Africa, from a developing country perspective. Many of the articles referenced were sourced from developed countries such as the United States of America, United Kingdom and Australia. The social, economic and political environments of developing countries are different from that of developed countries therefore, the research needs and interventions are also different (Willcox *et al.* 2007). The literature review revealed that the United States of America, United Kingdom and Australia have moved far beyond the analysis of basic factors affecting queues within pharmacies and the articles referenced could only be applied indirectly to the South African environment (Shimshak *et al.* 1981, Green *et al.* 2001, Cayirli and Veral 2003). This research therefore, used more theoretical, text book knowledge than the findings from referenced research

articles. This research will provide the baseline information necessary for future research as implemented in developed countries to reduce waiting times, such as improved patient and public perceptions of the public health care sector and demand planning strategies. Improvement is not a single, isolated event but a continuous process for an improved business position (Maister 1985) and this research was the first step of many for improving the mean waiting times at the outpatient pharmacies within the public health care sector in South Africa.

1.5 Delimitation and limitation of the research

1.5.1 Delimitations

The research was conducted at the SBAH outpatient pharmacy. The scope of the research did not extend to:

- Other pharmacies at the SBAH.
- Other academic, regional and district hospitals within GDH.
- The community health care centre and the primary health care clinics within GDH.
- The private sector hospital pharmacies within Gauteng.

1.5.2 Limitations

- No research articles were found which explicitly detailed the methodology for obtaining factors affecting waiting times within a public health care sector. The research methodology used incorporated factors found in the literature review together with the unconfirmed and undocumented factors cited by the pharmacy managers (Section 4: Case motivation) working within the GDH.
- The researcher, who is a pharmacist by profession with an excess of 10 years experience within the public health care sector, may have influenced the focus areas of this research.

- The reliance on pharmacy staff participating in the research, to complete the data collection form, may have resulted in minor variations within the data collection process as the bias of all the participants was not managed.
- The work study method of developing standard times may have been intrusive to some participants (Pycraft *et al.* 2004), although the confidentiality of the persons participating were maintained at all times.
- The research had the limitation of including only one hospital as the whole study, limiting the generalisation of this finding to other hospitals within the GHD.
- The research was performed at the SBAH for a period of only five days, and thus discounted all other variables, for example seasonality.
- A briefing session held, prior to the commencement of the research, with the pharmacy manager and all the staff members could have resulted in additional staff being deployed to the outpatient pharmacy, improved work ethics and greater effort by all staff members to better meet the demand made for pharmaceutical services during the five days of the research.
- The research did not consider the qualitative aspects of the dispensing process such as the efficacy of the medication prescribed for the clinical condition of the patients, the duplication of pharmacologically similar drugs, the potential of adverse drug interactions, side effects and the possible drug-drug, drug-food and drug-disease interaction as required by legislation (The South African Pharmacy Council (SAPC) 2008).

1.6 Assumptions

The assumptions made during the research are as follows:

- The recommendations made remain applicable on the premise that the research site context remains unchanged.
- All outpatient pharmacy staff members were willing participants in this research.
- The pharmacy manger had good scheduling competencies to ensure that the demand made for pharmaceutical services were continuously met

- The scheduling of staff to meet the demand for pharmaceutical services were not inflated during the period of research
- The competencies of the different categories of pharmacist assistants (basic level and post basic level) were as defined within their scope of practice.
- The factors identified during the literature review are all inclusive. This assumption was to ensure minimal scope creep during the research.
- The word “prescription” often used during the research report equates to a patient and will imply the workload for the SBAH outpatient pharmacy.

CHAPTER 2: LITERATURE REVIEW

Waiting time, a queue performance measure represents the disparity between the supply and the demand made on a system for services. The relationship between the demand and supply of services and the queuing theory is illustrated in Figure 1.

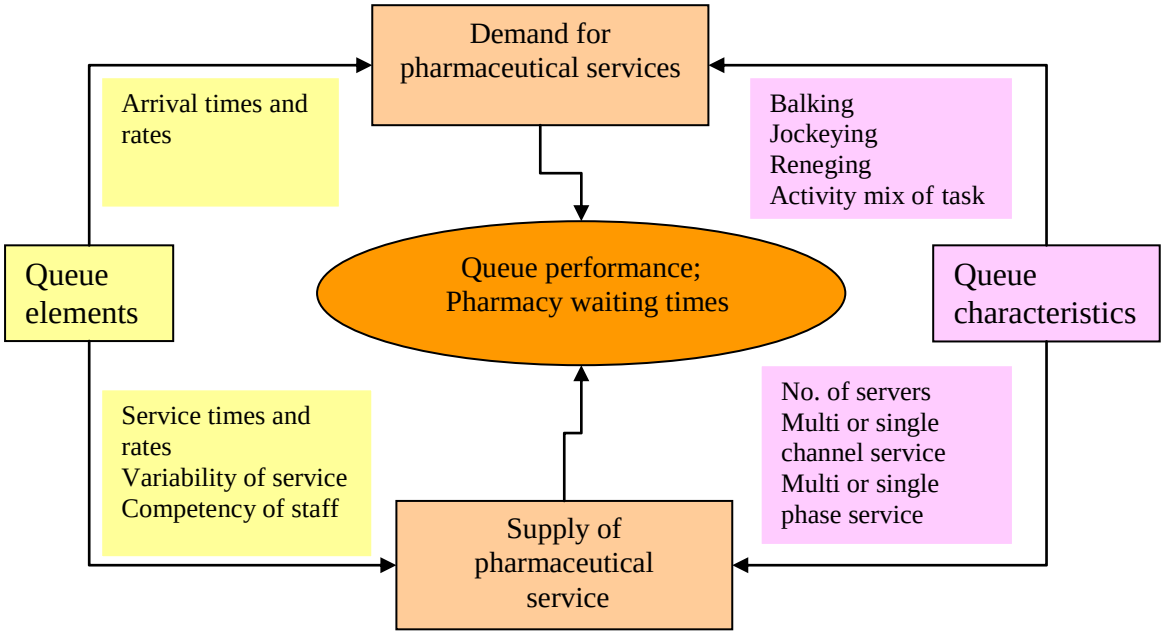


Figure 1: The relationship between the demand and supply of services and queuing theory (Developed by author using Stevenson 1989 and Hillier and Hillier 2003)

Demand for services is usually an external variable of a system and influenced by the activity mix of patients arriving at the outpatient pharmacy. Patients generally have the following options when sourcing services and include:

- Entering the service.
- Balking: the ability to refuse to enter the system (Stevenson 1989 and Hillier and Hillier 2003).
- Jockeying: the ability to change queues during the waiting period (Stevenson 1989 and Hillier and Hillier 2003).

- Reneging: the ability to leave the system, before being served (Stevenson 1989 and Hillier and Hillier 2003).

The queue elements such as balking, jockeying, reneging and the activity mix of the workload, together with the arrival time and rate, represent the demand for service. The queue characteristics such as the service time and rate, the competency of staff and the variability of services, together with the number of servers and the operational set-up of the service, represent the supply of pharmaceutical services.

It is of strategic importance to understand the queuing system employed within an organisation since this provides vital information to an organisation on how to differentiate itself from similar competitors. The competitive advantage for many organisations is contained within differentiated queue elements and characteristics (Stevenson 1989).

2.1 Understanding waiting times, waiting time guarantees and patient satisfaction

Pharmacy waiting time has been defined as the length of time from when a patient enters the pharmacy waiting area to the time the patient actually receives his/her medication and leaves the pharmacy (Warley and Schomme 1999, Backer 2002, Afolabi and Erhum 2003). Waiting time reported in the literature usually represents waiting time within a system, that is, it includes both the waiting and service times (Hillier and Hillier 2003).

All the authors (Maister 1985; Antonides *et al.* 2002; Buetow 2003; Eilers 2004) consider waiting time as an essential component of patient satisfaction and describe waiting time as the relationship between objective and perceived waiting time. The most reasonable course of action is to shorten the actual waiting time to improve patient satisfaction. However, if the actual waiting time cannot be shortened then the perception of the time waited must be influenced. Waiting time fillers should be used to enhance the experience of the service by providing information, entertainment or by engaging the customer (Maister 1985; Larson 1987, Antonides *et al.* 2002). Larson (1987) explains that the perception of waiting can be

positively influenced by providing feedback to patients about the expected waiting time and other delays. Having real time information about the magnitude and reason for the delay, positively influences perceptions as the patient feels more in control and is better able to select a strategy going forward (Larson 1987).

According to Kottler and Keller (2006) patient satisfaction can also be described as customer delivered value. Customer delivered value describes the relationship between the total customer value received versus the total cost to the patient. The total customer value that the patient receives is the sum of the product value, service value, personal value and the image value. The total cost that the customer has to pay for the service is the sum of the monetary cost, time cost, energy cost and the psychic cost. To increase the total customer value, organisations and patients must change their mindsets. Traditional organizations where the customer is at the bottom of the organizational chart need to be transformed to a modern customer centric organization where the customer is at the top of the organizational chart (Kottler and Keller 2006). The skills required to change the mindsets are different from the skills that are required to change business processes (Cabera 2007). Changing mindsets is an interaction between the mindset of all stakeholders, the situation and the reinforcing actions and results (Cabera 2007) as depicted in Figure 2.

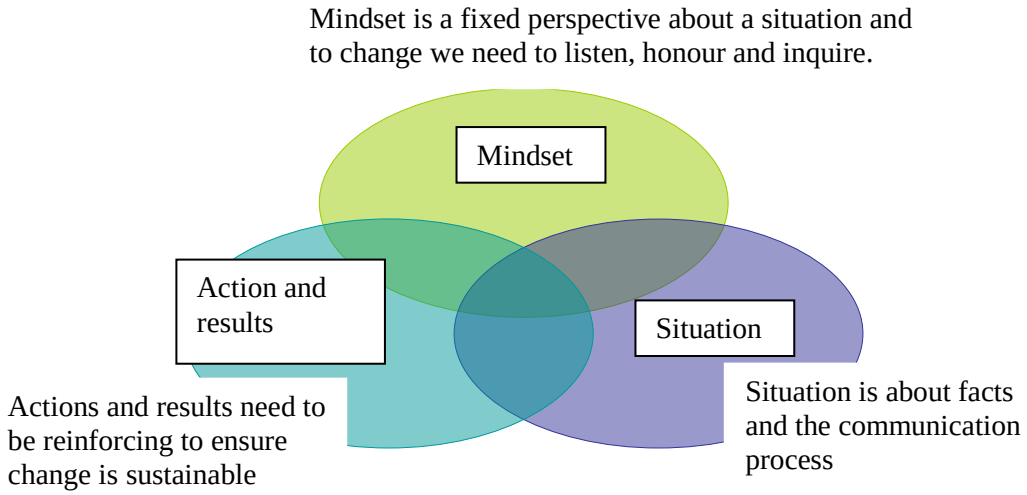


Figure 2: Changing mindsets (Cabera 2007)

There are no shortcuts to changing mindsets and all promises and guarantees made by an organisation must be kept since these promises will be carefully monitored by the patients. Sustainable change and continuously reinforcing actions of the organisation will eventually result in the mindset change required (Cabera 2007). It is critical not to over promise services which cannot be delivered, as this will erode the credibility and trustworthiness when promises are inconsistently fulfilled (Sommers 2006). Waiting time guarantees are best achieved only if they are aligned to the nature, value and the style of the organisation (Institute of Healthcare Improvements (IHI) 2008).

The GHD has given a waiting time guarantee to indicate its commitment to serve the patients within a specified period of time and as a signal of its reliable and consistent service (GDH 2008 and Kumar *et al.* 1997). The mean waiting time and the waiting time guarantee for the four academic hospitals within the GDH are provided in Table 1.

The greatest limitation of the current pharmacy waiting time measurement system used within the GDH is that the waiting time collected cannot be delineated into periods of greatest demand made on pharmaceutical resources. The waiting time is not associated with the controllable queue variable (Stafford and Aggarwal 1979), such as the number of servers, nor does it provide information on the uncontrollable queue variables (Stafford and Aggarwal 1979), such as arrival rates and service rates. Maister (1985) reported that it is during the period of greatest demand that patients experience the longest wait with the highest levels of patient dissatisfaction prevailing. The reliability of the waiting time monitoring system used by the GDH required validation with the findings of this research, to confirm its reliability and to ensure confidence in the system used. Therefore, the resultant objective from the literature review was as follows:

Objective 1: To compare and validate the GDH average waiting time with the average waiting time from the research.

Table 1: The average benchmark and the waiting times for the four academic hospitals

	Charlotte Maxeke Academic Hospital	Chris Hani Baragwanath Hospital	Steve Biko Academic Hospital	Dr. George Mukhari Hospital
Average pharmacy waiting time in minutes reported for the year 2005/6	188	128	22	220
Average pharmacy waiting time (minute) reported for the year 2006/7	155	61	34	173
Average pharmacy waiting time (minute) reported for the year 2007/8	98	62	40	88
The average pharmacy waiting times (minute) benchmarks set by institutions in March 2008	148	96	90	145
Average waiting time (minute) reported for the 1st quarter of 2008/9	224	59	65	89
The deviation in the waiting times (minute) from the benchmark	+76	-37	-27	-56

(Source: GDH 2008)

Patient satisfaction, within the private health care sector, does not focus on the time the patient waits for service but rather on the patient's experience of the service. Van der Berg (2008) reported in an informal interview that for a private health care sector, the random monthly client satisfaction survey is more focussed on the length of time before a patient is acknowledged after their arrival at the pharmacy rather than on the time the patient waits for a service. Waiting time is not measured as it is assumed that the patients in the queue are willing to wait for the service. Exemplary service to enhance the patient's satisfaction and experience at the pharmacy are considered critical for patient retention, as it influences revenue generation for the private health care sector (Health Systems Trust (HST) 2007).

2.2 The demand for pharmaceutical services

2.2.1 The arrival rate of prescriptions

The main task of the pharmacy operations manager is to forecast the demand and to subsequently reconcile the supply to meet the demand made for services (Pycraft *et al.* 2004). The demand, represented by the average daily number of patients seen at the SBAH outpatient pharmacy is known however, the arrival rates of patients period-by-period remained unknown. The pharmacies within the GDH generally do not utilise an appointment system and the arrival of patients at the outpatient pharmacy is dependent on the time most convenient to the patient. The patient's preference with respect to day of the week, day of the month and the time of the day to access pharmaceutical services is unknown and complicates the planning for the supply of pharmaceutical services. Knowing the actual demand made on pharmaceutical services period-by-period would allow managers to control and react to the demand with adequate capacity, period-by-period throughout the day (Pycraft *et al.* 2004).

In addition to the patient preference of when to utilise services, it is important to understand the activity mix (Pycraft *et al.* 2004) of prescriptions seen at the outpatient pharmacy as this could contribute to the streamlining of service delivery and processes. The activity mix or the different types of prescriptions generally seen at the outpatient pharmacy include:

- Repeat prescription: where the patients collect their repeat medication for their chronic illnesses to a maximum of 5 times without seeing a doctor (Department of Clinical Support services (DCCS) 2007).
- Acute or new prescription: where the patient consults with the doctor for a new or a chronic condition and where the doctor writes a new prescription for the patient (DCCS 2007).
- Priority prescription: represents acute or repeat prescriptions that receive preferential service (DCCS 2007). Priority prescriptions are often served first, disregarding the first-in-first-served queue principle and resulting in priority prescriptions increasing the waiting times for other patients in the queue (Hillier and Hillier 2003).

The research aimed to establish the arrival rates and the arrival distribution of the patients period-by-period throughout the day and to investigate the activity mix of patients seen at the SBAH outpatient pharmacy. Therefore, the resultant objectives from the literature review were as follows:

Objective 2: To determine the average arrival rate and the inter-arrival distribution for the prescriptions at the SBAH outpatient pharmacy.

Objective 3: To determine the average number of acute, chronic and priority prescriptions seen at the SBAH outpatient pharmacy.

2.2.2 Rational drug prescribing

In 1985, the World Health Organisation defined rational drug use as follows: "rational drug use requires that the patient receive medicines appropriate to their clinical needs, in doses that meet their individual requirements, for an adequate period of time and at the lowest cost to the patient and community" (Management Sciences for Health (MSH) 1997, United Nation High Commission For refugee (UNCHR) 2006). The number of items prescribed per encounter is often used as an indirect indicator of rational drug prescribing and the adherence to the essential drug list serves as an indirect indicator of the appropriate utilisation of the different levels of the health care system (MSH 1997, UNCHR 2006). Rational drug use is however, a wider concept than just the number of items prescribed and the adherence to the essential drug list and includes a qualitative aspect of prescribing which was not included within the scope of the research (MSH 1997).

The greater the number of items per prescription, the longer it should takes to prepare and dispense the medication to the patient, resulting in longer waiting times for all patients. The longer and the more complex the prescription is, the greater the likelihood of the medication being used inappropriately (MSH 1997) and the greater the risk that a pharmacist may dispense a potentially harmful combination of a drug**:**drug interaction (Science Daily 2007). An indirect method used to monitor the rational use of drugs (MSH 1997) and the demand made on pharmaceutical services at the SBAH outpatient pharmacy

was to monitor the number of line items prescribed per prescription. Therefore, the resultant objective from the literature review was as follows:

Objective 4: To determine the average number of line items prescribed per prescription at the SBAH.

Doctors at all hospitals within the GDH are required to initiate treatment for their patients, where applicable, using the medications listed on the primary health care essential drug list (Department of Health (DOH) 2003). The essential drug concept as defined by the World Health Organisation states that the "The essential drug list, a list of essential drugs that satisfy the health care needs of the majority of the patients, must be available at all times in adequate amounts … are drugs which are the most efficacious, safe and cost effective…and which form the basis of any health care system" (MSH 1997, UNCHR 2006). The essential drug list serves as a guideline and does not necessarily exclude drugs deemed necessary to effectively treat a patient's condition. Within the South African public health care sector the essential drug concept is applied at all levels of care and the number of drugs available at a health facility increases with the level of health care provided (MSH 1997, UNCHR 2006). The essential drug concept is applied to all 3 levels of health care within the GDH, which are classified as follows:

- Academic (tertiary or specialised) hospital care, where the services provided include those that are beyond the scope of the specialist and require the input of a highly specialised and registered sub-specialty (National Department of health (NDH) 2006 and GDH 2007).
- Regional (secondary) hospital care, where services provided include services which are sometimes beyond the scope of the generalist and require the input of the registered specialist (NDH 2006 and GDH 2007).
- District hospital and Community Health Care Centres, where services are provided within the skills base of a general medical practitioner and do not require the intervention of a specialist. This includes preventative, curative, rehabilitative and general surgery with general anaesthetics (NDH 2006 and GDH 2007).
- District PHC clinic level of care, where services are provided within the skills base of the nurse practitioner (NDH 2006 and GDH 2007).

The rationale for the selection of a limited number of essential drugs for each level of care is that it leads to improved drug supply management, lower cost and more rational prescribing (MSH 1997).

Since there are no penalties for directly accessing secondary or tertiary care, it remains the prerogative of the patient to choose the level of service they prefer and will use (Dawson *et al.* 2006). The perception and reputation that doctor-driven services are superior to the nurse-driven services could be a reason for the high attendance of patients at an inappropriate level of health care (GDH 2007). The inappropriate use of tertiary services to provide primary health care results in an increase in the workload for a limited human resource capacity (GDH 2007), resulting in longer waiting times extending into unplanned overtime services. Continuous increases in the workload results in staff burnout, a decrease in staff motivation and a lack of job satisfaction (Society of Hospital Pharmacist of Australia (SAPH) 2004). With sustained, increased workload the aim of service delivery changes from effective service delivery to efficient service delivery, that is, the focus shift from quality to quantity of service.

In the United Kingdom most health care is provided by the State-owned National Health Services, and to access non-emergency hospital services, a patient must first visit a General Practitioner who acts as a gatekeeper to secondary care (Dawson *et al.* 2006). Similarly, in South Africa the primary health care system is the first port of call for most non-emergency conditions however, the hearsay reasons for not utilizing the primary level of care in South Africa are similar to those found in the research paper: Specialist Diabetic Clinics in Primary Care (Rhodes *et al.* 2003) and include the following; patients' preference for hospitals, unknown quality of care at primary clinic level, lack of transportation, inconvenient location of clinic for the patient and the ability of the doctor to take care of the patient without down referring the patient. The patient utilizing the inappropriate level of care must therefore, endure (or "pay") a waiting time for the services they prefer (Dawson *et al.* 2006). The concern however remains that the inappropriate utilization of tertiary or secondary services increases the waiting times for patients who are appropriately utilizing the correct level of health services.

The strategic goal of the GDH is to strengthen services rendered at the district health level and to ensure that the primary health care is the mainstay of health care services provided within the province (GDH 2007). This has the goal of ensuring that all patients have equal access to more specialised secondary or tertiary care (GDH 2007). However it has been reported that a "large number of patients" are still accessing health care from the secondary and tertiary level and not from the primary level of care (GDH 2007). The resultant effect of the inappropriate use of the health care services within the GDH contributes to the long waiting times, crowded waiting rooms at academic and regional hospitals together with costly and ineffective service delivery (GDH 2007). The most appropriate solution would be the strengthening of the down referral system, for patients to access healthcare at the correct level of care. The down referral system should not be seen as a process to shift the workload but a sound strategy for the effective utilisation of scarce human resources and limited funding (GDH 2007).

The magnitude of patients utilizing the inappropriate level of care had not been previously quantified. The research aimed to theoretically estimate the number of patients "inappropriately" utilizing the tertiary level of care by reviewing the medication prescribed on the prescriptions. For this research, all prescriptions where only the primary level essential drugs were prescribed were regarded as being down referable for clinical management at a lower level of care. It must however, be noted that this approach provided only a superficial estimation of the appropriate utilization of tertiary level as it did not take into consideration other factors deemed necessary for the clinical management of the patients. Therefore, the resultant objective from the literature review was as follows:

Objective 5: To theoretically determine the number of prescriptions that could be down referred to the primary level of care for clinical management.

2.2.3 Packing of medication during the dispensing process

Organisations can respond to demand in one of three ways: either by resource-to-order, make-to-order or make-to-stock. Pharmaceutical services within the Gauteng public health

care sector respond to demand by making use of the make-to-order and make-to-stock planning and control methods. The make-to-stock response to demand normally practised within the public health care sector requires the pre-packing of frequently used medication into standardised patient-ready treatment packs as per the essential drug list and the standard treatment guidelines (DOH 2003). The advantage of pre-packing is: that it minimizes errors during the dispensing process, it allows for easier and faster dispensing, and the pre-packing process can be performed by a basic pharmacist assistant under the direct supervision of a pharmacist in a controlled environment (MSH1997). The make-to-stock response is employed only for medication with a high volume usage, thereby decreasing the risk of expiry or obsolescence of the medication. The high demand placed on pharmaceutical services within the public sector is efficiently managed mainly due to the use of the make-to-stock approach of demand planning. The unavailability of a high usage medication in patient-ready packs can result in an excessive packing of medication during the dispensing process, thereby increasing waiting times. The number of medication items requiring packing during the dispensing process and the additional time required to pack an item during the dispensing process, have not been previously quantified within the public health care sector. Therefore, the resultant objective from the literature review was as follows:

Objective 6: To determine the average number of medications requiring packing and the additional time required to pack an item during the dispensing process at the SBAH outpatient pharmacy.

2.2.4 Availability of medication

Medication availability is perceived to be an indicator of systems efficiencies (MSH 1997) and needs to be monitored continually. Medication availability is however a function of the cost of holding stock versus the cost of lost sales (MSH 1997, Singh 2006, Hillier and Hillier 2003). The service level, a measure used to indicate medication holding within an organisation, represents the number of orders that can be fulfilled on first request (MSH 1997). The service level of an organisation can be increased by increasing the stock

holding however, this may not always be the desired option. The optimal service level for any organisation is where the total expected cost is at its lowest as shown in Figure 3.

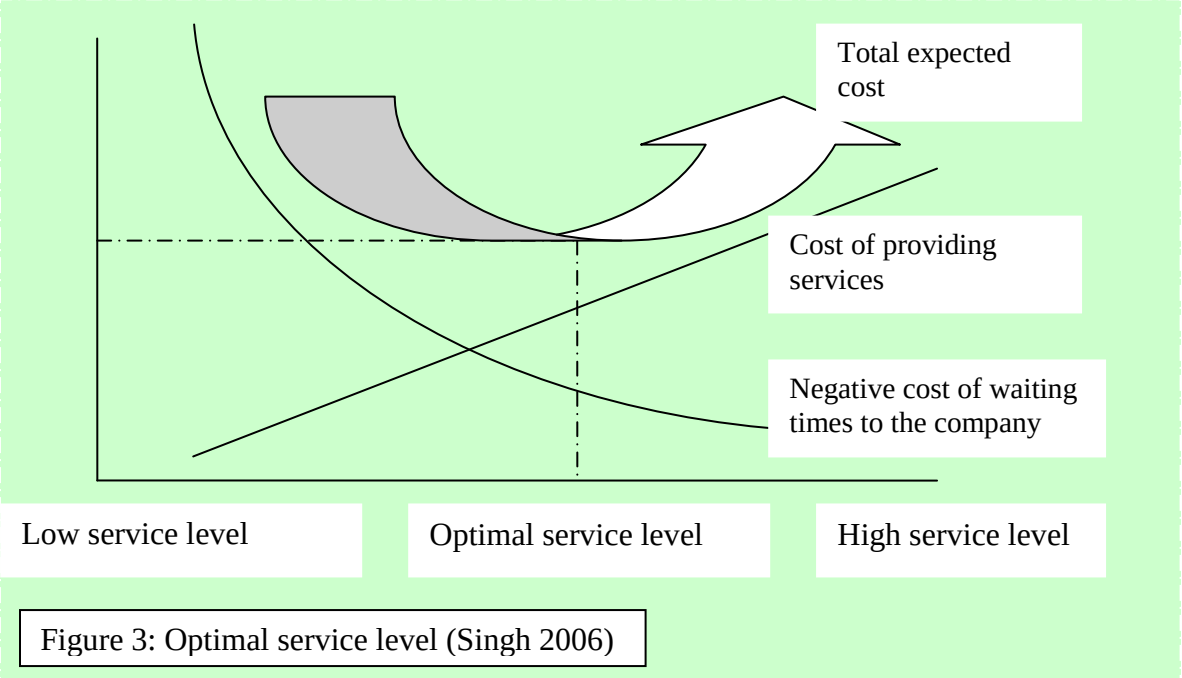


Figure 3: Optimal service level (Singh 2006)

The total expected cost curve represents the combination of the cost of providing services and the negative cost of waiting (MSH 1997, Singh 2006, Hillier and Hillier 2003). Organisations often attempt to maximise on the patient's waiting cost wherever possible, in an effort to minimize the organisation's cost of providing services (Singh 2006).

An important goal of pharmaceutical services is to ensure that medication is available at all times to maintain confidence in the medication supply chain within the public health care sector. An out of stock situation, a complete absence of the medication, is usually a result of inadequate stock holding, procurement delays and changes in doctor's prescribing habits (MSH 1997). The absence of critical or essential medication in stock requires communication with the prescriber to identify an alternative drug for the patients (MSH 1997) thus extending the waiting time for the patient and negatively affecting patient satisfaction. Patient satisfaction is at its lowest when the patient is required to return to the hospital to collect an item which was out of stock, especially since the patients within the

GDH do not have the option of sourcing their medication from other preferred providers, owing to financial constraints. Sub-optimal treatment (MSH 1997) remains a concern if patients do not return to the hospitals to collect items out of stock. The consequence of an out of stock situation is clearly understood by all health care providers however, the magnitude of the occurrence within the GDH has not been previously investigated. Therefore, the resultant objective from the literature review was as follows:

Objective 7: To determine the number of prescriptions with an item out of stock and the additional time required to manage an out of stock situation at the SBAH outpatient pharmacy.

2.3 The supply of pharmaceutical services

2.3.1 Staff availability

The supply of pharmaceutical services within the public health care sector is generally dependent on the availability of staff. The high vacancy rates of approximately 30% for pharmacists (GDH 2006) and the high turnover rate, especially of the community service pharmacists, hinders the rendering of a sustainable and quality pharmaceutical service. The Society of Hospital Pharmacist of Australia (2004) describes a vicious cycle of staff losses resulting in even greater staff losses: it states that during staff shortages the workload per pharmacist increases and translates into overtime, resulting in an infringement on personal time and burnout. Reluctance to perform paid overtime is probably due to the non-market related overtime pay. During critical staff shortages many of the specialised pharmaceutical services provided are reduced in favour of outpatient workload, resulting in a decrease in job satisfaction. Formal and in-service training are also curtailed due to time constraints, affecting motivation, staff competency and job satisfaction, resulting in staff losses. Natarajan (2007) mentions five main retention factors for pharmacists in the public sector, and these include: remuneration benefits, professional development, training and skills enhancement, additional allowances and adequate staffing structures. Based on the above it is apparent that many of the retention factors mentioned by Natarajan (2007) are suspended or discontinued during periods of high workload, resulting in job dissatisfaction

which leads to staff losses. Staff availability is critical to the supply of pharmaceutical services. The South African Health Review (2007) states, that for an organisation to provide an adequate and effective service it requires the foundation of an adequately skilled workforce. Despite the importance of human resources in providing health care services, this component has not been prioritised and will remain on the backburner as long as it remains an operational and not a strategic issue (Paradath *et al*. (2008), Hongoro and McPake 2004).

Pharmacy managers are often faced with the task of having to assign scarce resources to other equally important competing pharmacy functions other than outpatient pharmacies. Devoting resources to one task means compromising on other tasks since not all tasks can be dealt with simultaneously (MSH 1997). MSH (1997) states that allocating scarce resources should ideally be based on:

- The urgency of the task, that is to those tasks that have an absolute deadline.
- The relevance of the task, that is to those tasks which are most central to the long-term strategic goal of the organisation.
- The impact of the task, that is to those tasks which have the greatest impact on the activity or problem or have the greatest threat or opportunity for the organisation.

In the public health care sector all patients arriving for the day must be served. The workload at the out patients pharmacy often takes preference over other work areas due to the "urgency" of the workload. Staff schedules favouring the outpatient pharmacy at the expense of the other pharmaceutical activities are often mistaken for an effective solution to improving the waiting time of patients but this may have long term negative consequences for the provision of a holistic quality pharmaceutical service. Capacity planning is further complicated as it involves human behaviour and it is difficult to control the interaction with customers at all times (McQuitty *et al.*2005). Capacity planning and control is not a straightforward calculation of determining only the number of servers required to meet the demand for service, but must incorporate other measures such as utilization and efficiency ratios and the activity mix of the service (Pycraft *et al.* 2004). An ideal system of capacity planning and control must include strategies to manage

demand, that is to effectively change or manage demand to fit the organisation's capacity (Pycraft *et al.* 2004); however, this process requires measures for informed decision making. The current system of capacity planning to cope with demand fluctuation at most public sector hospitals' outpatient pharmacies is a level capacity plan combined with some chase demand plans, where capacity is adjusted to meet the fluctuating demand (Pycraft *et al.* 2004).

An important queue measure is the number of servers directly serving the patient apart from the staff working in a multi phase system or behind the scenes (Stevenson 1989 and Hillier and Hillier 2003). The research aimed to quantify the service rate and distribution and the number of servers serving the patients at the SBAH outpatient pharmacy. Therefore, the resultant objective from the literature review was as follows:

Objective 8: To determine the service rate, the service distribution and the average number of servers serving the patients at the SBAH outpatient pharmacy.

2.3.2 Competency of pharmacist assistants

The high attrition rate of pharmacists within the GDH has become a chronic state and will require a long term strategy to correct. Both the private and public health care sectors have looked to mid-level workers as a way of dealing with the growing shortage of professional human resources (SAHR 2005). Pharmacist assistants are important members of the pharmacy profession and acceptable work performance by pharmacist assistants will ensure that routine activities within the scope of practice of the pharmacist assistants can be delegated to this category of staff with confidence (MSH 1997). Similar to the assistant practitioner in the UK (Cronin 2007) the pharmacist assistants must perform their scope of practice under direct personal supervision of the pharmacist, with a level of knowledge and skill beyond that of the traditional healthcare support worker (Cronin 2007). Cost effective service provision requires that tasks be performed by the appropriate level of skilled staff (Al-Shaqha and Zairi 2000) releasing the pharmacist to perform value-adding clinical activities in the field of pharmaceutical care and clinical pharmacy. Competency as a

function of continuous formal and in-service training remains the responsibility of both the employer and the employee (MSH 1997).

Consistency and reliability of services are positive attributes of service delivery and must be ensured for patient satisfaction (CSZ 2007). Consistency can be defined as conforming to a regular pattern, adhering to the same principles or course of action and is all about discipline (Longmans dictionary 1982, CSZ 2007). Reliability is the ability to perform assigned tasks predictably at all times, in as much as ensuring that services provided can be trusted and are dependable (Longmans dictionary 1982 and Fujitsu 2005). Clients expect to be treated the same every time they request a service (CSZ 2007). For pharmaceutical services both consistency and reliability are essential during the dispensing process to ensure that the right drug in the right quantity is issued to the right patient every time (MSH 1997).

Performance variability due to errors or other factors can be defined as the "change in the performance from one service encounter to another with the same provider…and it is the human element that introduces the heterogeneity to the service" (McQuitty *et al.* 2005). The performance variability can be either actual or perceived variations in performance (McQuitty *et al.* 2005). Variations in services represent risks and uncertainty and are therefore, viewed as a negative attribute in service delivery (McQuitty *et al.* 2005). Errors within a system introduce performance variability that requires considerable effort and time to rectify and which negatively impacts on the waiting times of patients. Pycraft *et al.* (2004) explains performance variability as being either an error in judgment resulting in a deviation from normal standard procedures, or it could be a violation which is a deliberate action clearly contrary to standard operating procedures (Pycraft *et al.* 2004). Both the error in judgment and the violation need to be proactively addressed upon identification to ensure consistency of service delivery. The service time or the service rates are also important proxy indicators against which consistency and reliability of service can be measured.

Kumar *et al.* (1997) states that patients are very observant of the service provided to customers ahead of them, confirming or disconfirming their prior beliefs about the service delivery of an organisation. The perception of social injustice and the non-linear negative queuing experience is intensified if patients notice a violation or non-adherence to the first–in-first-out principle (Larson 1987). Slips and skips are two measures of social injustice in queues. "A slip is when another individual joins the queue sometimes later but enters service before you, and you have been victimised by a slip as the second arriving customer has skipped you by" (Larson 1987). For the customer arriving second there is a certain sense of satisfaction. Every slip creates a skip (Larson 1987). Larson (1987) states that customers prefer to wait longer in disciplined queues than in undisciplined, multi-line queues which demonstrate a high chance of social injustice. The multi-phase dispensing process used within the public sector makes it difficult for the patient to observe the actual process being followed behind the scenes and it has been reported by Kumar *et al.* (1997) that if individuals cannot observe the process being followed this can increase the stress during the waiting experience and the perceived social injustice can be intensified. Slips and skips within a system can be perceived as inconsistent service delivery.

Error rates are often used as an indirect indicator for the rational use of drugs during the dispensing process. The following errors types usually occur during the dispensing process (MSH 1997, UNHCR 2006) and include:

- The retrieval of the wrong medication or ingredient.
- Inaccurate counting, compounding and packing.
- Inadequate identification and labelling.
- Mistakes in the delivery of the medication to the patients, such as the wrong dosage and route of administration.
- Inadequate instruction on the use of medication.

To validate the concerns regarding the reliability of services provided by the pharmacist assistants, the research tested the competency of pharmacist assistants by investigating the number of errors made during the dispensing process and the additional time taken to

rectify an error on a prescription. Therefore, the resultant objective from the literature review was as follows:

Objective 9: To determine the average number of errors made during the dispensing process and the additional time required to rectify an error at the SBAH outpatient pharmacy.

2.4 Observing workflows, bottlenecks and other factors affecting the dispensing process

All processes or sub-processes exist to provide a service for the patient (Kimbelee *et al.* 2005). The main reason for observing and informally mapping the process flow is to identify the logic of the flow, duplicate activities and non-value adding activities (Al-Shaqha and Zairi 2000, Afolabi and Erhum 2003).

Observation is one of the many data collection techniques but requires considerable skills in planning and piloting (Bell 2005). A concern with the observation technique is usually the researcher's subjectivity affecting the interpretation of the situation, the process and the people (Bell 2005). For this research, observation was only a small part of the research and was performed to validate the quantitative findings of the research where applicable. The format used was an unstructured observation aided by the use of a checklist providing a clear idea of what needs to be observed without giving the exact details to be observed (Bell 2005).

The attitude of staff towards patients was an important aspect observed during the research however, since attitude is a highly complex subject and comprises a state of mind, the observation was limited to the most obvious behaviour displayed (Du Plessie 2007). The observation attempted to identify:

- The positive behaviour identified through the following action: taking initiative, being open, friendly and honest, respect for confidential information, organised

arrangement of work processes, display awareness of productivity and produce accurate work (Du Plessie 2007).

- The negative behaviours identified through the following actions: arriving late for work, longer tea and lunch times, lack of respect for patients, long telephone conversations and the use of cell phones during normal working hours ((Du Plessie 2007).

The research report would be incomplete without the direct observation of both the internal and external factors affecting the demand and supply of pharmaceutical services. Therefore, the resultant objective from the literature review was as follows:

Objective 10: To observe the workflow, layout, attitude of staff and other interruptions affecting the supply of pharmaceutical services at the SBAH outpatient pharmacy.

2.5 Literature review summary

The key to building an improved health care system requires unconventional thinking, challenging norms, developing an understanding of the relationships within a system, and thinking of new ideas concerning intentional intervention.

Extensive research has been done in the field of improving services at the pharmacy departments of hospitals. However no two research articles investigated the same topics using the exactly same methodology. This clearly highlights the differences that exist between organizations and the fact that all research is ultimately adapted to determine the needs or circumstances of the organization. The literature revealed that the commonly used interventions to understand waiting times included:

- Perception surveys of services (Antonides *et al.* 2002, Eilers 2004).
- The use of advanced analytical queue models for scheduling of staff (Green *et al.* 2001).
- Optimization of the use of staff and budgets (GHD 2007).

- Value creation and re-engineering (Al-Shakhaa and Zaira (1998), Al-Shaqa and Zaira 2000).
- New expanded roles and responsibilities for clinical pharmacists and pharmacist technicians/ assistants (Al-Shakhaa and Zaira 1998, Al-Shaqa and Zaira 2000).

No universal, acceptable waiting time could be found in literature as a benchmark for pharmacies. Most articles reported waiting time improvements as a percentage improvement. A plausible explanation for the lack of waiting time benchmarks in literature may be because many organizations take advantage of the patient's willingness to wait for services in an effort to decrease the cost of providing services (Singh 2006). The literature review has shown that the time the patient is prepared to wait is multi-factorial and includes social, economic, cultural and political issues and varies from one queue situation to another.

For this research the demand and supply factors affecting pharmaceutical services at the SBAH outpatient pharmacy were explored through the following sets of objectives formulated during the literature review.

Objective 1: To compare and validate the GDH average waiting time with the average waiting time from the research.

Objective 2: To determine the average arrival rate and the inter-arrival distribution for the prescriptions at the SBAH outpatient pharmacy.

Objective 3: To determine the average number of acute, chronic and priority prescriptions seen at the SBAH outpatient pharmacy.

Objective 4: To determine the average number of line items prescribed per prescription at the SBAH.

Objective 5: To theoretically determine the number of prescriptions that could be down referred to the primary level of care for clinical management.

Objective 6: To determine the average number of medications requiring packing and the additional time required to pack an item during the dispensing process at the SBAH outpatient pharmacy.

Objective 7: To determine the number of prescriptions with an item out of stock and the additional time required to manage an out of stock situation at the SBAH outpatient pharmacy.

The supply of pharmaceutical services was investigated through the following objectives:

Objective 8: To determine the service rate, the service distribution and the average number of servers serving the patients at the SBAH outpatient pharmacy.

Objective 9: To determine the average number of errors made during the dispensing process and the additional time required to rectify an error at the SBAH outpatient pharmacy.

The qualitative aspect of the research was investigated through the following objective:

Objective 10: To observe the workflow, layout, attitude of staff and other interruptions affecting the supply of pharmaceutical services at the SBAH outpatient pharmacy.

CHAPTER 3: RESEARCH METHODOLOGY

The research investigated demand and supply of pharmaceutical services through a quantitative phase in order to quantify the factors affecting queues in pharmacies and a qualitative phase including the observation of the layout, process and the attitude of staff (Bell 2005 and Bradford 2007).

3.1 The quantitative data collection

The quantitative research approach utilised two data collection forms:

- The General Data Collection Form (Annexure 1) was used to monitor the arrival times and the activity mix of all patients arriving at the SBAH outpatient pharmacy over the five day period of the research.
- The Dispensing Process Data Collection Form (Annexure 2) was used to perform a detailed investigation into a sub-set of the total prescriptions received. The Dispensing Data Collection Form was used to record the times taken to perform the various processes of the dispensing function by using the "stopwatch" approach (Pycraft *et al.* 2004) where each staff member participating in the research recorded their own activity times. The detailed investigation performed using Annexure 2, was considered the sample population of the research.

The Dispensing Process Data Collection Form (Annexure 2) was used to gather detailed dispensing information for the sample population seen at the SBAH outpatient pharmacy and included:

- The personnel involved in the dispensing process.
- The activity mix of patients seen at the outpatient pharmacy.
- The number of items prescribed per prescription.
- The number of items requiring packing during the dispensing process, number of errors and the number of items out of stock.
- The timing of all activities performed during the dispensing process.

The total population database created from the information collected using the General Data Collection Form assisted with the calculation of the:

- Average arrival rates and the inter-arrival times.
- Activity mix of prescriptions seen at the outpatient pharmacy
- Average service rate.

The sample population database created from the data collected using the Dispensing Process Data Collection Form assisted with the calculation of the:

- Number of items requiring packing and the additional time required to pack an item during the dispensing process.
- Number of errors made by pharmacist assistants and the additional time required to rectify the error.
- Number of prescriptions with an out of stock item and the additional time taken to manage an item out of stock.
- Number of line items prescribed per prescription.
- Appropriate utilisation of the tertiary level of care.
- Average waiting time for the patients at the SBAH outpatient pharmacy.

Figure 4, is a graphic representation indicating whether the population or sample database was used in computing the qualitative aspect of the research.

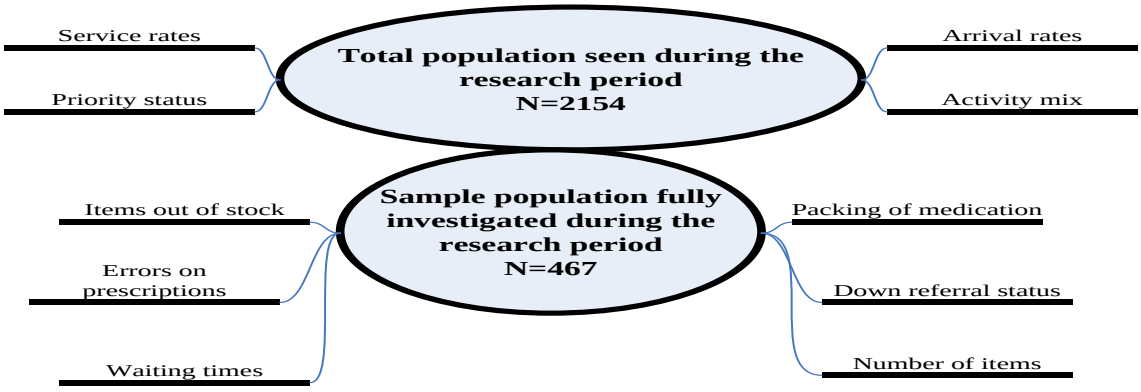


Figure 4: The quantitative approach to data collection (source: developed by the author)

A commonly used dispensing process within the public health care sector is shown in Figure 5, which is ideally suited to the use of a "stopwatch approach" to time each activity within the dispensing process.

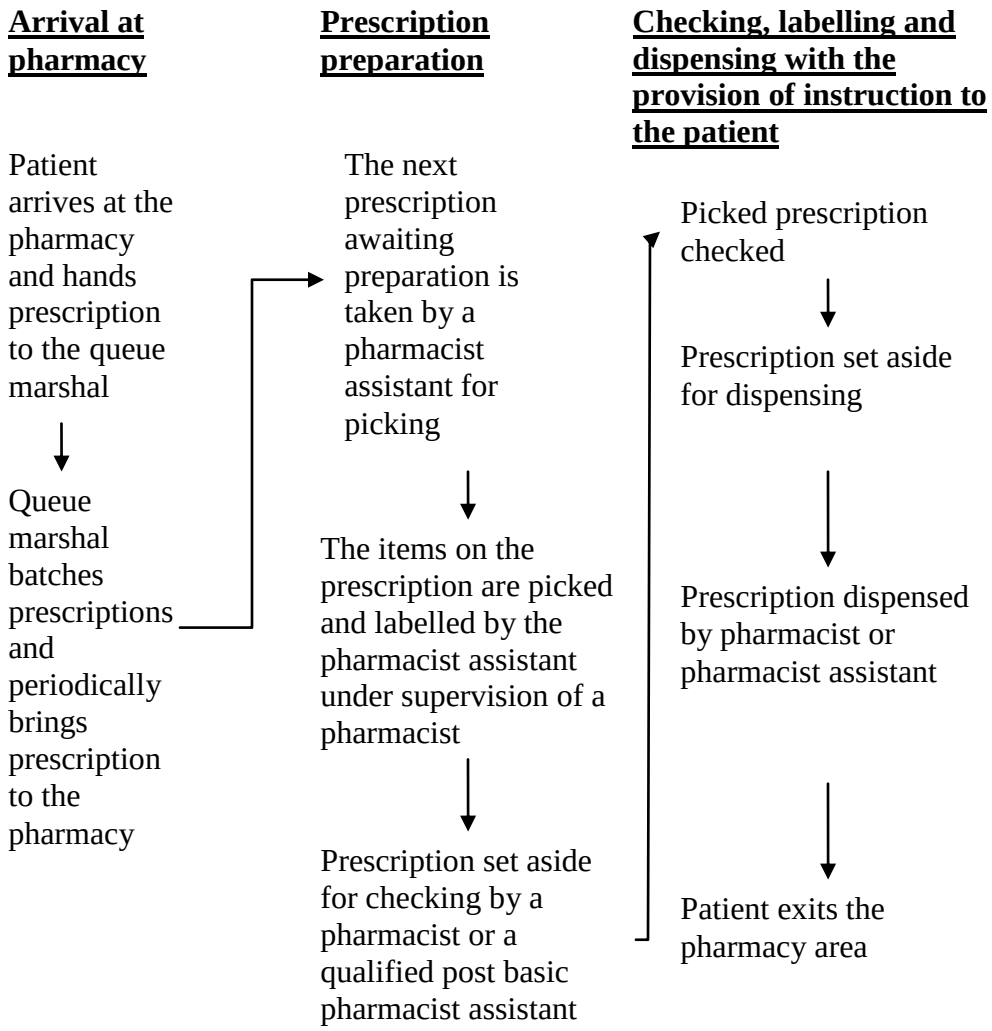


Figure 5: The dispensing process (Source: developed for the research by the author)

A description of the dispensing process followed at the SBAH is as follows:

- The receiving, preparation, checking, labelling and dispensing of a prescription constituted the sequential dispensing process with clearly identified start and end activities.
- The dispensing process should ideally begin with the interpretation and evaluation of the prescription where the prescription is checked for legality, authenticity and is

therapeutically assessed against the patient's condition by a pharmacist or a qualified post basic assistant. At the SBAH outpatient pharmacy this process was only performed during the prescription checking and labelling phase and not during the prescription preparation phase performed by the basic level pharmacist assistants (RSA 1997).

- The preparation phase of the dispensing process usually includes the selection of the medication, the packing and the labelling of the medication as prescribed. This preparation phase is often referred to as picking.
- The labelling process should preferably be performed together with the picking process but at the SBAH outpatient pharmacy this function was performed during the checking and labelling process. The labelling process must ensure that the labels used contain all the required patient details, clear direction on the use of the medication and the storage requirements as required by legislation (SAPC 2008).
- The final dispensing process includes the provision of adequate information and directions on the use of medication to the patient to ensure compliance and must be performed by either a pharmacist or a qualified post basic pharmacist assistant (RSA 1997, SAPC 2008).

A closer examination of the dispensing process in Figure 5, shows that the total waiting time for the patient in the system comprises of many secondary service and waiting times (Fourie *et al.* 2007) and include the following:

- Waiting time for the prescription to be picked.
- Waiting time for the prescription to be checked and labelled.
- Waiting time for the prescription to be dispensed.
- Service time for picking the prescription.
- Service time for checking and labelling the prescription.
- Service time for dispensing the prescription.

3.2 Qualitative data collection

The qualitative aspect of the research was conducted through the observation of best practices and areas of concerns within the SBAH outpatient pharmacy. The observation phase was a small part of the research aimed at providing clarity and explanations for the findings of the quantitative aspect of the research. The qualitative research was an unstructured observation using a guiding checklist of variables for consideration without pre-empting the exact details of these variables (Bell 2005). The qualitative phase of the research was performed using a Checklist for Observation (Annexure 3) and the 30 Minute Data Recording Sheet (Annexure 4).The main areas for observation in Annexure 3 included the following:

- The identification of cross-flows of processes and /or the obvious duplicate or redundant processes.
- Utilisation of available capacity.
- The neatness and orderliness of the arrangement of the medication within the outpatient pharmacy.
- The observable positive and negative behaviour of the staff.
- The utilisation of the different cadres of staff at the outpatient pharmacy.

3.3 Research approval

The following approvals were sought from the relevant stakeholders before the commencement of the research:

- The Director: Clinical Support Services, responsible for the pharmaceutical services within the Gauteng province.
- Wits Business School‘s research committee / panel.
- Written approval from the Management of SBAH.
- Written approval from the Pharmacy management at the SBAH.

Patient’s consent was not required for the research since no confidential patient information was recorded.

3.4 The study population

The population comprised all the prescriptions seen at the SBAH outpatient pharmacy over a period of 5 working days, from the 31 October 2008 until the 6 November 2008. An academic hospital was selected because it displayed many of the relationships and complexities shown and explained in the systems dynamics diagram for pharmaceutical services as depicted in Figure 6 (See Section 4: Case Motivation).

The inclusion criteria were as following:

- The hospital had to be categorised as an academic hospital within the GDH.
- The dispensing process had to use a multi-phase system with either a single or multi-channel service.
- Prior written approval had to be given by both the hospital's Chief Executive Officer and the pharmacy manager to perform the waiting time research at the outpatient pharmacy.
- Queue marshals had to be available to assist with the data collection process.

3.5 Sampling methodology

The minimum sample size *n*, for this research was obtained using the maximum error of estimate equation for a population proportion (Israel 1992, Larson and Faber 2000), as follows:

$$n = p\ q\ (z_c / E)^2$$

Where *n* is: The minimum size of sample required to estimate the population proportion *p*.

Where *p* is: The population proportion of successes in the population.

Where *q* is: The population proportion of failures in the population and equal $(1 - p)$.

Where z_c is: The confidence level required. The z_c for 95% equals 1.96.

Where *E* is: The maximum error of estimate or the level of precision required; it is the range within which the true value of the population is estimated to be and is often expressed as a percentage.

Since there were no previous studies from which the *p* and *q* value could be estimated for the population seeking health care at the academic hospitals within the GDH, the researcher assumed maximum variability where p = 0.5 (Israel 1995) and this resulted in the largest possible sample size for the research. Isreal (1998) states that it is better to have too large a sample and come within the maximum error of estimate *E,* than to have too small a sample size and exceed the maximum error of estimate, *E.* A total sample size of 384 prescriptions was calculated for the research at a 95% confidence level and a 5% level of precision or maximum error of estimate. To obtain a sample size of 384 prescriptions or greater, every 5^{th} prescription arriving at the SBAH outpatient pharmacy was subjected to a detailed investigation using the dispensing data collection form (Annexure 2) with the exception of Friday when every 3^{rd} prescription was subjected to a detailed investigation. The total number of documents prepared was guided by the workload analysis for the SBAH outpatient pharmacy using Annexure 5. All data collection forms were pre-numbered to assist with the process of data collection and to identify data lost to the research.

3.6 Briefing session and a pilot project

A briefing session was held with the pharmacy manager of the research site regarding the purpose and the methodology of the research. The benefits of the briefing session included the following:

- Buy in from the pharmacy managers and all staff.
- All staff were fully briefed and all concerns regarding the research were addressed prior to the collection of data.
- All staff were assured that there were no “hidden agendas” especially with the timing of processes involved in dispensing.

- The identification of a pharmacist who could assist and support the research process if required.
- The identification of the most appropriate time interval to be used for reporting the research finding.

The risks of a briefing session included:

- The implementation of "best practices" within the pharmacy prior to the research.
- Staffing supplemented for the research period.
- The deployment of the most competent staff to the outpatient pharmacy during the research period.

Discussions were held with the pharmacy manager emphasising the risks of the briefing session and the consequence of incorrect findings from the research, if the research environment was changed unduly.

A pilot project was conducted on Thursday, 30 October 2008 which ensured that all staff participating in the research had an opportunity to have their questions answered and understood the requirements of the data collection form and the research in general. The findings of the pilot project were not included in the analysis of research data.

3.7 Data analysis

Descriptive and inferential methods were utilised to describe the quantitative and qualitative findings of the research. The statistical analysis includes average measures and graphical representation for the findings of the research (Larson and Fable 2000). For the case methodology the statistical robustness was not an absolute necessity. The findings of the research are further explained in relation to the findings of the literature review or the case motivation (Tellis 1997).

3.8 Validity and reliability

The data collected was essentially objective data and the reliability of the data was ensured through its repetitive collection. The reliability of the data collection was emphasised by briefing all the participants in the research about the method of data collection and the need for consistent data collection (Bell 2005 and Bradford 2007). The reliability of the qualitative aspect of the research was subject to the interpretation of the researcher. However, since the qualitative aspect of the research is only a small part of the research and referenced only during the probable explanation of the quantitative findings, the bias was contained within acceptable limits of interpretation.

The validity of the data, means to collect data as intended (Bell 2005 and Bradford 2007) was ensured by briefing all participants in the research on the understanding and reasons for the data collection. Only the essential data required was collected. Internal validity was demonstrated as the data collection forms accurately captured the required data in an objective manner. External validity was not a requirement since the case methodology used does not allow for the generalisation of the findings of this research to other hospitals within the GHD.

CHAPTER 4: CASE MOTIVATION

Waiting time is a highly complex subject, and waiting time improvement is not a single, isolated event but a continuous process for an improved business position (Maister 1985). Zineldin (2006) clearly states that no matter how complex or difficult the improvement process may be it needs to be done because: "Good quality of care is a right of all patients and the responsibility of all staff within the hospital".

Often undocumented and unconfirmed factors cited for the long pharmacy queues by the pharmacy managers working within the public health care sector, had not been considered for inclusion into formal research, with the resultant loss of valuable input. Pharmacy managers within the public health care sector often cite the following pharmacy related and external factors contributing to the long pharmacy waiting times.

The pharmacy related or internal factors cited for the long pharmacy queues are as follows:

- Lack of an appointment system to assist with demand and capacity planning.
- Lack of a standard service times for the dispensing process against which service delivery could be measured.
- Inadequate staff to meet the demand for services.
- Lack of funding for overtime and / or the reluctance to perform overtime.
- Large number of errors made by pharmacist assistants during the dispensing process.
- Out of stock situations resulting in patients returning at a later date to collect their medication requiring additional service time per day.
- Other critical pharmacy activities competing for scarce resources.
- Language barriers during counselling.
- Low morale of staff due to high workload.
- Staff experiencing burnout resulting in high absenteeism.
- Time wasters such as telephones calls and administration function.

The external factors cited for the long pharmacy queues are as follows:

- Late starting times of outpatient clinics as doctors often only attend to outpatients after the morning ward round.
- The erratic arrival of patients throughout the day hinders effective capacity planning.
- Heavy workload due to the large number of repeat prescriptions seen at the hospitals.
- Inappropriate utilisation of services by patients.
- Non adherence to the standard treatment guidelines by doctors requiring the packing of medication from bulk stock during the dispensing process.
- The large number of medications prescribed per prescription, requiring additional service time.

A close examination of the undocumented and unconfirmed factors mentioned above may initially appear random, but are in fact interrelated as can be seen from the system dynamics model in Figure 6. The lack of integration of services, between the different departments within an organization or within a department, is usually responsible for the best laid improvement plans going awry (Al-Shakhaa and Zaira, 1998). Integration of functions can eliminate waste with regard to duplicate functions, redundant activities, standardisation of processes and identifying delay components that increase the waiting times and patient dissatisfaction (Al-Shaqha and Zairi 2000; Afolabi and Erhum 2003). The current disparity between the supply and demand for pharmaceutical services is often seen as a pharmacy operation failure. However, a closer examination of the systems dynamics model shows how the behaviour observe, that is, the long pharmacy waiting times at the outpatient's pharmacy, actually indicates a lack of co-ordinated functions between the different departments of a health care institutions.

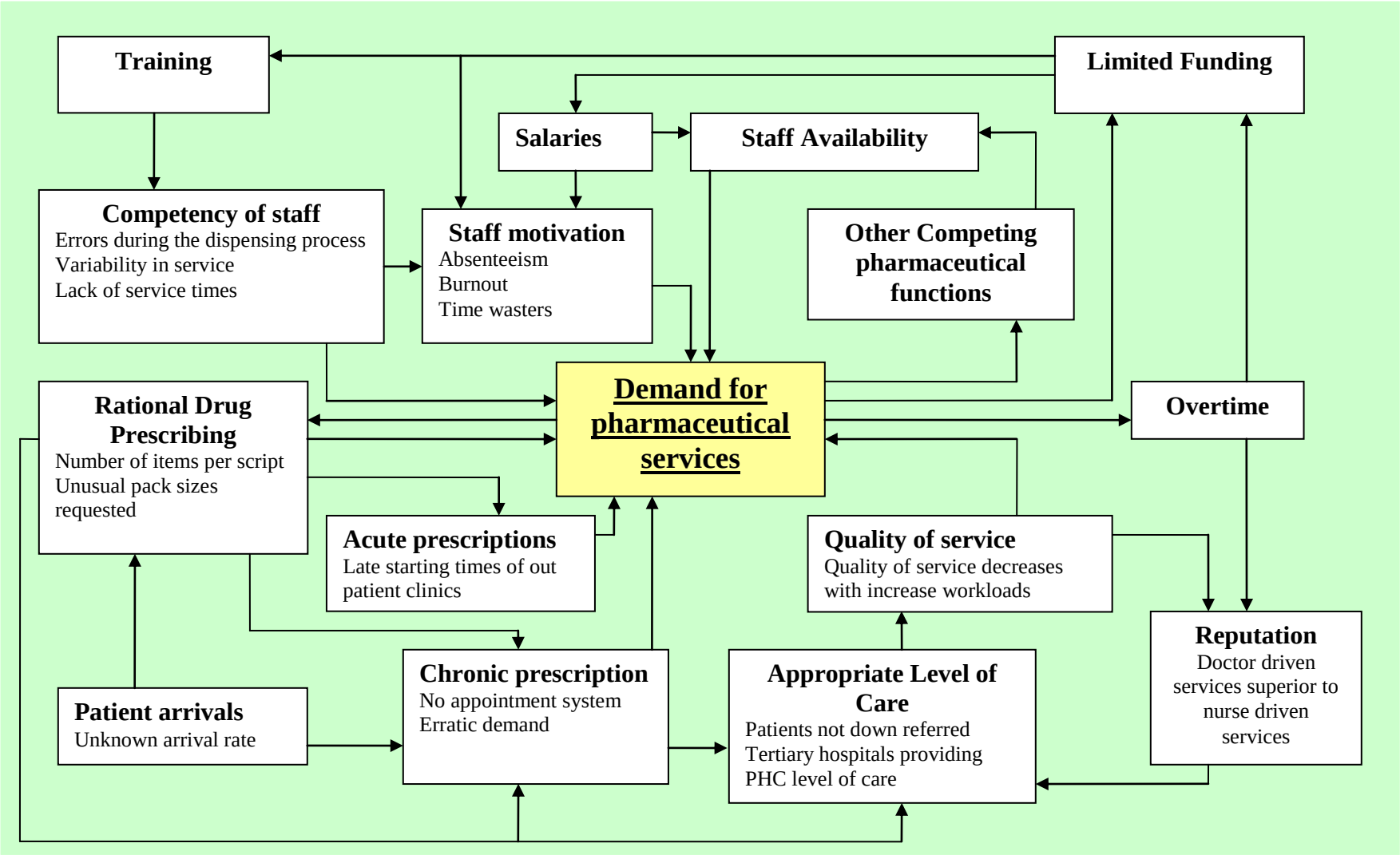


Figure 6: System dynamic model for pharmaceutical service (developed by the author for the research)

The systems dynamic is a qualitative methodology describing relationships between many variables (Lane *et al.* 2000, Gordon 2008). An analysis of the demand made on pharmaceutical services as depicted in Figure 6 showed that many of the variables within the systems dynamic model could in actual fact be quantified in order to either confirm or disprove the reasons cited for the long waiting times at the outpatient pharmacy. Therefore, both the internal and external factors cited for the long waiting queues were formally included into this research.

CHAPTER 5: PRESENTATION OF THE RESULTS

The chapter will commence with a research document reconciliation followed by the presentation of the results supporting the different objectives of the research.

5.1 Document reconciliation

All documents used during the research were prepared and numbered in advance to facilitate the research document reconciliation.

Table 2: Document reconciliation

Day of the week	Total number of documents prepared	Total number of documents used	Total number of documents recovered	Total number of documents missing	Percentage (%) loss of documentation	Number of detailed investigation documents used	Number of detailed investigation documents recovered	Number of incomplete detailed investigation
Friday (Fri)	463	295	275	20	3.6%	100	100	7
Monday (Mon)	702	464	435	29	4.2%	92	83	8
Tuesday (Tues)	570	459	456	2	0.3%	92	86	10
Wednesday (Wed)	659	518	465	53	9.5%	103	100	20
Thursday (Thurs)	639	569	523	46	7.0%	114	98	13
Totals	3033	2305	2154	150	6.5%	501	467	58

Of a total of 3033 documents prepared, 2305 documents were used. Two thousand one hundred and fifty four of the 2305 documents used, were recovered, resulting in a 93.5% document recovery for the research period. Of the detailed investigation performed, the document recovery was 93.2%. The greatest document loss of 9.5% occurred on Wednesday and the lowest of 0.3% occurred on Tuesday. Of the 2154 prescriptions recovered, 28 prescriptions did not have the dispensing time recorded and were excluded from the calculations of the average population waiting times; however, the documented arrival times were used for the calculation of the arrival rates. Fifty eight of the 467

detailed investigations were incomplete in several areas; nonetheless all available data was used wherever relevant. The resultant outcome was that varying sample sizes were used during the computation of the different objectives depending on the availability of data. Eighty six (4%) of the all the documents recovered during the research were considered incomplete.

The minimum sample size for the research was calculated as 384 prescriptions using the maximum error of estimate equation for a population proportion (Israel 1992, Larson and Faber 2000) at a 95% confidence level and a 5% level of precision. The sample population evaluated in the research was 1.2 times that of the minimum sample size required and was approximately one fifth of the total population seen during the research period. Although not a controlled variable during the research, an equal number of acute and repeat prescriptions were evaluated in the sample population.

5.2 Results pertaining to objective 1: To compare and validate the GDH average waiting time with the average waiting time from the research

For the purpose of this research report, time is reported using the following format: 00:00:00 which represent hours : minutes : seconds. Queue theory reports all its measures as means or averages (Stevenson 1989 and Hillier and Hillier 2003) and as a result the findings of this research are all averages.

5.2.1 The average waiting times for the patients at the SBAH outpatient pharmacy

The waiting time information calculated for the SBAH outpatient pharmacy is shown in Table 3. The average waiting time was calculated by averaging all the differences between the time when the prescription arrived at the outpatient pharmacy and the time when the prescription was dispensed. A total of 2126 prescriptions were used to calculate the population waiting time and a total of 409 detailed investigations were used to calculate the sample waiting time. The population waiting time indicates that each prescription at the

SBAH outpatient pharmacy will wait on average 01:04:47, while the sample waiting time indicates that the prescriptions would wait on average 01:07:15. The difference between the population and the sample waiting time was 00:02:28.

Table 3: The average waiting time for the SBAH outpatient pharmacy

	Population waiting times (*N = 2126)	Sample waiting time (*n = 409)	Population waiting times as adjusted for prescriptions set aside (*N = 2025)
Fri	00:51:07	00:58:25	00:43:56
Mon	01:02:42	01:03:23	01:00:32
Tues	01:05:18	01:06:52	00:58:36
Wed	00:51:53	00:51:16	00:47:56
Thurs	01:32:55	01:36:17	01:23:22
Average	01:04:47	01:07:15	00:58:52

*N, refers to the total research population while n, refers to the sample population of the research.

During the final dispensing process 191 (18%) of the total research population failed to collect their medication when called. These prescriptions were subsequently set aside until the patient arrived and queried the availability of their medication. The process of prescriptions being set aside was only discovered during the pilot phase of the research therefore, not formally included in the research methodology. Ninety of the 101 prescriptions set aside had the time documented when the prescriptions were set aside, and the time when the patient finally arrived to collect their medication. To quantify and eliminate the impact that the prescriptions set aside had on the calculation of the population waiting time, the time when the prescriptions were dispensed was replaced with the time when the prescriptions were set aside, as this ideally represented the time when dispensing would have occurred if the patients collected their medication when called. The population waiting time as adjusted for the prescriptions set aside was 00:58:52, 00:05:55 less than the population waiting time. The 101 prescriptions set aside without the required time information were excluded from the calculation of the population waiting time as adjusted. On average 38 prescriptions were set aside daily.

The number of prescriptions that waited longer than the population waiting times and the waiting time benchmark set by SBAH outpatient pharmacy are shown in Table 4.

Table 4: The number of prescriptions that waited longer than the waiting time benchmark

Day	Population waiting time	The longest waiting time per day	The shortest waiting time per day	Number of prescriptions that waited longer than the population waiting time	Number of prescriptions that waited longer than the 90 minute benchmark
Fri	00:51:07	05:06:00	00:03:33	50	23
Mon	01:02:42	04:32:00	00:08:00	115	44
Tues	01:05:18	06:45:00	00:06:00	179	97
Wed	00:51:53	04:41:00	00:07:00	29	84
Thurs	01:32:55	08:01:00	00:07:00	411	204
Average / Totals	01:04:47			784	452

Seven hundred and eighty four prescriptions waited longer than the population waiting time while 452 prescriptions waited longer than the 90 minute waiting time benchmark set for the SBAH outpatient pharmacy. The shortest waiting time for any prescription was 00:03:33 and the longest was 08:01:00. A total of 145 prescriptions waited as follows:

- One hundred and nine prescriptions waited longer than 2 hours.
- Twenty prescriptions waited longer than 3 hours.
- Ten prescriptions waited longer than 4 hours.
- Three prescriptions waited longer than five hours.
- One prescription waited longer than six hour.
- One prescription waited longer than seven hours.
- One prescription waited longer than eight hours.

The total waiting time for the prescription in the system comprised of many secondary waiting and service times tabulated in Table 5.

Table 5: The secondary waiting and service times for the sample population

Day	Waiting time 1: waiting time before a prescription was picked	Waiting time 2: waiting time before a prescription was checked and labelled	Waiting time 3: waiting time before a prescription was dispensed	Total waiting time for a prescription in the queue	Service time 1: service time to pick a prescription	Service time 2: service time to check and label a prescription	Service time 3: service time to dispense a prescription	Total service time for a prescription	Total waiting time for a prescription in the system
Friday	00:18:09	00:09:41	00:20:59	00:48:49	00:03:37	00:04:26	00:01:33	00:09:36	00:58:25
Monday	00:31:08	00:14:39	00:08:22	00:54:09	00:03:25	00:04:16	00:01:33	00:09:14	01:03:23
Tuesday	00:28:24	00:17:30	00:13:29	00:59:23	00:02:43	00:03:13	00:01:33	00:07:29	01:06:52
Wednesday	00:20:35	00:13:02	00:11:46	00:45:23	00:01:52	00:02:28	00:01:33	00:05:53	00:51:16
Thursday	00:51:02	00:22:38	00:15:20	01:29:00	00:02:19	00:03:25	00:01:33	00:07:17	01:36:17
Average	00:29:52	00:15:30	00:13:59	00:59:21	00:02:47	00:03:34	00:01:33	00:07:54	01:07:15

(n=409)

An explanation of the methodology used to derive the secondary waiting and service times for a prescription is shown in Figure 7.

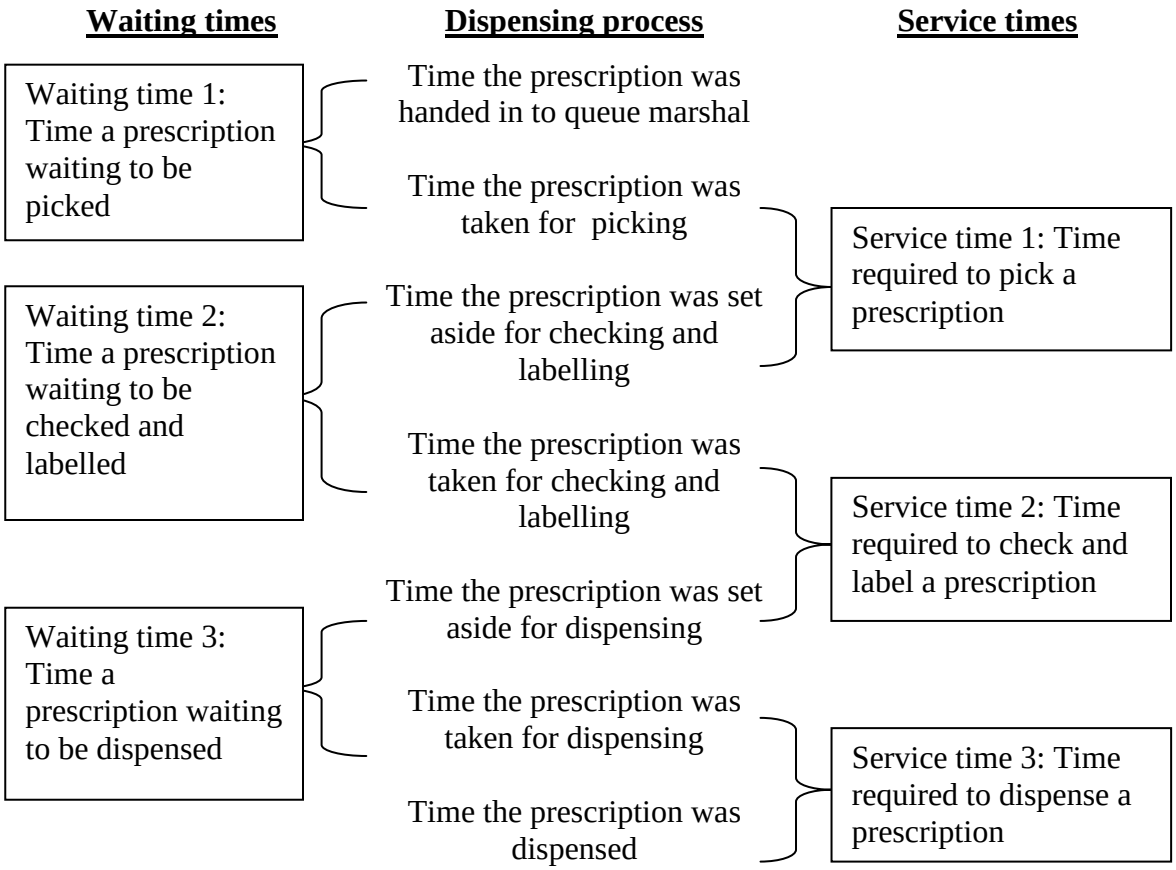


Figure 7: Analysis of the secondary waiting and service times (Developed by the author for the research)

The secondary waiting and service times that constituted the waiting time of prescriptions in the system consist of the following:

- Waiting time 1 (WT1): the time a prescription waited in the queue before it was picked, was the difference between the time when the prescription was handed in to the queue marshal and the time when the prescription was taken for picking. The average time the prescription waited for service to begin was 00:29:52.
- Waiting time 2 (WT2): the time a prescription waited in the queue before it was checked and labelled was the difference between the time when the prescription

was set aside for checking and labelling and the time when the prescription was taken for checking and labelling. The average time before a prescription was checked and labelled was 00:15:30.

- Waiting time 3 (WT3): the time a prescription waited in the queue before it was dispensed was the difference between the time when the prescription was set aside for dispensing and the time when the prescription was taken for dispensing. The average time before a prescription was dispensed was 00:13:59.
- Service time 1 (ST1): the service time taken to pick a prescription was the difference between the time when the prescription was taken for picking and the time when the prescription was set aside for checking and labelling. The average time taken to pick a prescription was approximately 00:02:47.
- Service time 2 (ST2): the service time taken to check and label a prescription was the difference between the time when the prescription was taken for checking and labelling and the time when the prescription was set aside for dispensing. The average time taken to check and label a prescription was 00:03:34.
- Service time 3 (ST3): the time taken to dispense a prescription was calculated as the difference between the time when the prescription was dispensed and the time when the prescription was taken for dispensing. The time when the prescriptions was taken for dispensing was not always recorded on the dispensing data collection form and subsequently the researcher observed 63 random prescriptions being dispensed and calculated an average dispensing time of 00:01:33, which was subsequently used throughout the research.
- The total waiting time in the queue was the sum of waiting time 1, 2 and 3 and was 00:59:21.
- The total service time of the prescription was the sum of service time 1, 2 and 3 and was 00:07:54.
- The total waiting time in the system of 1:07:15 was the sum of the time the prescription waited in the queue and the total service time required to prepare the prescription

Twelve of the 90 prescriptions set aside were detailed investigation and which were used to determine the secondary waiting and service times for only the prescriptions set aside, which are as follows:

- WT1: waiting time before a prescription was picked was 00:17:28.
- WT2: waiting time before a prescription was checked and labelled was 00:08:04.
- WT3: waiting time before a prescription was dispensed was 01:28:38.
- Total waiting time in the queue was 01:48:21.
- ST1: service time to pick a prescription was 00:03:04.
- ST2: service time to check and label a prescription was 00:02:49.
- ST3: service time to dispense a prescription was 00:01:33.
- Total service time was 00:06:54.
- Total waiting time in the system was 01:55:15.

The research provided relevant waiting time information against which the routinely recorded waiting times from the GDH Quality Assurance Directorate was validated. In addition, the quantitative methodology used, demonstrated the ability to delineate the average sample waiting time into secondary waiting times and service times.

5.3 Results pertaining to objective 2: To determine the average arrival rate and the inter-arrival distribution for the prescriptions at the SBAH outpatient pharmacy

The research aimed to establish the arrival rate and inter-arrival distribution of prescriptions at the SBAH outpatient pharmacy period-by-period throughout the day. The arrival time from the electronic patient numbering system was used in the calculation of the arrival rate per 30 minute time interval. The difference between consecutive arrival times of prescriptions provided the inter-arrival times used to create the inter-arrival distribution of prescriptions seen at the SBAH outpatient pharmacy.

The arrival of the research population was categorised into acute and repeat prescriptions per 30 minute time interval as shown in Table 6.

The arrival of the acute prescription: One thousand two hundred and eighty nine acute prescriptions arrived during the research period, averaging to 258 acute prescriptions per day and 14 acute prescriptions per 30 minute time interval. The highest arrival of acute prescriptions was 52 on Monday during 12h31and 13h00, and the lowest was zero arrivals for many of the 30 minute time intervals after 14h00 on all days of the research.

The arrival of the research prescription: Eight hundred and sixty five repeat prescriptions arrived for the research period, averaging to 173 repeat prescriptions per day and 10 repeat prescriptions per 30 minute time interval. The greatest arrival rate of repeat prescriptions was 71 patients on Thursday during 7h00 and 7h30 followed by 56 arrivals on Wednesday for the same time interval, with zero arrivals recorded for many of the 30 minute time intervals after 14h00 for all days of the research.

The arrival of all prescription: A total of 2154 prescriptions arrived during the research period, averaging to 431 arrivals per day and 24 arrivals for each 30 minutes time interval. The greatest arrival rate was 75 prescriptions on Thursday between 7h00 and 7h30 followed by 71 arrivals on Monday during 12h31 to 13h00. The busiest day of the research period was Thursday with 523 arrivals and the least busy day was Friday with 275 arrivals per day.

Table 6: The average arrival rate of acute, repeat and all prescriptions

	Average arrival rate of acute prescriptions per 30 minute time interval					Average arrivals rate of repeat prescriptions per 30 minute time interval					Average arrival of all prescriptions per 30minute time interval				
Time interval	Fri	Mon	Tues	Wed	Thurs	Fri	Mon	Tues	Wed	Thurs	Fri	Mon	Tues	Wed	Thurs
7h00 - 7h30	16	9	7	4	4	24	31	36	56	71	40	40	43	60	75
7h31 - 8h00	1	0	1	3	1	9	0	20	21	10	10	0	21	24	11
8h01 - 8h30	6	3	2	3	6	10	12	13	28	23	16	15	15	31	29
8h31 - 9h00	10	5	11	8	6	13	19	21	15	28	23	24	32	23	34
9h01 - 9h30	1	12	20	18	24	1	21	16	8	18	2	33	36	26	42
9h31 - 10h00	10	31	20	14	24	9	13	13	21	16	19	44	33	35	40
10h01 - 10h30	17	35	15	41	35	11	10	9	22	5	28	45	24	63	40
10h31 - 11h00	18	25	34	21	32	12	5	11	3	4	30	30	45	24	36
11h01 - 11h30	20	31	28	23	30	9	8	5	4	11	29	39	33	27	41
11h31 - 12h00	20	26	20	29	31	4	3	9	3	3	24	29	29	32	34
12h01 - 12h30	20	18	30	28	24	4	5	2	8	8	24	23	32	36	32
12h31 - 13h00	8	52	31	21	21	3	19	6	2	5	11	71	37	23	26
13h01 - 13h30	13	2	23	18	19	2	0	3	1	8	15	2	26	19	27
13h31 - 14h00	3	15	20	9	17	1	3	9	5	2	4	18	29	14	19
14h01 - 14h30		13	8	12	15		1	2	6	1		14	10	18	16
14h31 - 15h00		4	8	9	13		3	2	1	4		7	10	10	17
15h01 - 15h30		1			3			1		1		1	1		4
15h31 - 16h00															
Actual arrivals per day	163	282	278	261	305	112	153	178	204	218	275	435	456	465	523
Arrivals for the total research period	1289					865					2154				
The average arrivals per day	258					173					431				

Capacity planning requires not only the arrival rate of prescriptions, which is, the number of prescription arriving during a specified time period, but also the inter-arrival times, which is how quickly prescriptions arrive in relation to each other. The inter-arrivals time was calculated using the total population (N= 2154) seen at SBAH outpatient and the results are shown in table 7.

Table 7: The inter-arrival times of prescriptions

Time Interval (minutes)	Fri	Mon	Tues	Wed	Thurs
0 - 59 sec	158	225	159	212	258
1 – 1:59	69	141	212	164	187
2 – 2:59	19	34	53	44	37
3 - 3:59	5	11	15	19	15
4 – 4:59	8	7	7	11	7
5 - 5:59	4	2	3	2	4
6 - 6:59	1	4	2	6	0
7 - 7:59	1	2	0	2	3
8 - 8:59	4	0	0	1	4
9 - 9:59	0	0	1	0	2
10 - 10:59	3	1	2	1	2
11 - 11:59	0	3	0	1	1
12 - 12:59	0	0	1	0	0
13 - 13:59	0	0	0	0	1
14 - 14:59	0	0	0	0	0
15 - 15:59	0	3	0	2	0
16 - 16:59	2	0	0	0	0
17 - 17:59	0	0	0	0	0
18 - 18:59	0	0	1	0	0
19 - 19:59	0	0	1	0	1
20 - 20:59	0	0	0	0	1
21 - 21:59	0	0	0	0	0
22 - 22:56	0	0	0	0	0
23 - 23;56	0	0	0	0	0
24 - 24:56	1	0	0	0	0
Totals	275	433	457	465	523

The inter-arrival times for the prescriptions were as follows:

- One thousand and twelve prescriptions arrived within 00:00:00 to 00:00:59 of each other.
- Seven hundred and seventy three prescriptions arrived within 00:01:00 to 00:01:59 of each other.
- One hundred and eighty seven prescriptions arrived within 00:02:00 to 00:02:59 of each other.
- Sixty five prescriptions arrived within 00:03:00 to 00:03:59 of each other.

The methodology used, again demonstrated the ease with which the arrival rate and the inter-arrival times were calculated using a single data element, the arrival time. The methodology also provided the opportunity to separate the arrivals of prescriptions into the activity mix of prescriptions seen at the SBAH outpatient pharmacy.

5.4 Results pertaining to objective 3: To determine the average number of acute, chronic and priority prescriptions seen at the SBAH outpatient pharmacy

The number of acute and repeat prescriptions that arrived at the SBAH outpatient pharmacy was calculated under results pertaining to objective 2. The inclusion of the priority prescription into the activity mix of prescriptions seen at the SBAH outpatient pharmacy was deemed important because priority prescriptions are generally served first disregarding the first-in-first-served principle.

The activity mix of acute and repeat prescriptions as determined in objective 2 is summarised in Table 8. The total research population of 2154 prescriptions seen at the SBAH outpatient pharmacy comprised of 1289 (60%) acute prescriptions and 864 (40%) repeat prescriptions.

Table 8: The activity mix of prescriptions

Day	The total number of acute prescriptions	The total number of repeat prescriptions	The arrival of all prescriptions for the research period	Average % of acute prescriptions	Average % of repeat prescriptions
Fri	163	112	275	59%	41%
Mon	282	153	435	65%	35%
Tues	278	178	456	61%	39%
Wed	261	204	465	56%	44%
Thurs	305	218	523	58%	42%
Average for the research period	1289	865	2154	60%	40%

The activity mix of prescriptions to include the priority prescriptions is shown in Table 9.

Table 9: The activity mix of prescriptions including the priority prescriptions

Day	The arrival of all prescription for the research period	The total number of prescriptions which received priority service	Average % of prescriptions which received priority services	Total number of acute prescriptions which received priority service	Total number of repeat prescriptions which received priority service
Fri	275	9	3%	8	1
Mon	435	33	8%	29	4
Tues	456	37	8%	32	5
Wed	465	33	7%	31	2
Thurs	523	13	2%	10	3
Average for the research period	2154	125	6%	110	15

One hundred and twenty five (6%) of all prescription arrivals for the research period received priority service. Of the 125 prescriptions that received priority service 88% were

acute prescriptions and 12% were repeat prescriptions. The activity mix of the research population including the priority prescriptions is summarised as follows:

- 1179 (55%) of prescriptions were acute prescriptions.
- 110 (5%) of prescriptions were priority acute prescriptions.
- 845 (39%) of prescriptions were repeat prescriptions.
- 15 (1%) of prescription were priority repeat prescriptions.

The arrival rate of the priority prescriptions per 30 minute time interval is shown in Table 10.

Table 10: The average arrival of priority prescriptions

	Number of priority prescriptions per 30 minute time interval				
Time interval	Fri	Mon	Tues	Wed	Thurs
7h00 - 7h30	2	0	1	1	0
7h31 - 8h00	1	0	2	0	0
8h01 - 8h30	0	1	0	0	0
8h31 - 9h00	0	0	0	2	1
9h01 - 9h30	0	0	5	1	0
9h31 - 10h00	0	0	7	1	0
10h01 - 10h30	0	4	4	6	0
10h31 - 11h00	2	1	4	2	0
11h01 - 11h30	2	2	5	5	1
11h31 - 12h00	0	8	1	3	1
12h01 - 12h30	0	1	3	4	5
12h31 - 13h00	2	9	2	1	0
13h01 - 13h30	0	0	1	2	4
13h31 - 14h00	0	3	1	2	1
14h01 - 14h30	0	4	1	2	0
14h31 - 15h00	0	0	0	1	0
15h01 - 15h30	0	0	0	0	0
15h31 - 16h00	0	0	0	0	0
Actual arrivals for the day	9	33	37	33	13
Total arrivals for the research period	125				
Average arrivals per day	25				

A total of 125 prescriptions received priority service during the research period, averaging to 25 prescriptions per day. The highest number of arrivals of priority prescriptions occurred on Monday during 12h31 and 13h00, which coincided with the highest arrivals of acute prescriptions as shown in Table 6. The highest number of priority prescriptions was seen on Wednesday and the lowest on Friday.

The categories and the reasons why patients were prioritised are as follows:

- Patients who have been prescribed a Schedule 6 medication were prioritised because of an additional process step to prepare and dispense the Schedule 6 medication and because the patients requiring a Schedule 6 medication were often in extreme pain.
- Radiotherapy and oncology patients were prioritised because they were at high risk of acquiring an infection while waiting in the patient waiting areas.
- Wheelchair, deaf and disabled patients qualified for priority service because the waiting area was not conducive to accommodate the needs of these disable patients.
- Chronic ambulatory peritoneal dialysis (CAPD) or renal failure patients qualified for priority service because they were acutely sick patients.
- Casualty patients were patients who were brought into casualty for urgent medical treatment. Once stabilised and discharged from casualty, either the patients themselves, the nurse or the patient's family were prioritised to receive the prescribed medication.
- Transport patients were patients who have been up-referred to SBAH to receive specialist treatment. Transport was usually provided to such patients by the referring hospital and to allow for the timely return of the patient and transport, the prescriptions were prioritised.
- Occasionally elderly patients and mothers with sick children were also considered for priority service.

The priority categories and the number of prescriptions per priority category are shown in Table 11.

Table 11: The number of prescriptions per priority category

Day of the week	Schedule 6 prescriptions	Radiotherapy patients	Oncology patients	Wheelchair patients	CAPD patients	Patients using hospital transport	Casualty patients	Deaf patients	Disable patients	Total
Fri		3	2	4						9
Mon	19	7	1	3		1	1		1	33
Tues	15	9		9		1	1	2		37
Wed	16	7	1	5	2	2				33
Thurs	6	3		1			2		1	13
Totals	56	29	4	22	2	4	4	2	2	125

Thirty seven prescriptions on Tuesday received priority service while only 9 prescriptions received priority service on Friday. The prescriptions prioritised were for the following categories:

- Fifty six (48%) for the category Schedule 6.
- Twenty nine (23%) for the category radiotherapy.
- Twenty two (18%) for the category wheelchair.
- Less than 5 prescriptions each for all other priority categories.

Prioritization occurred using the non pre-emptive method, that is, once a server commenced with serving a prescription the service was completed without interruption even if a prescription with a higher priority arrived (Hillier and Hillier 2003). The queue marshal alerted the pharmacist assistants of the arrival of a priority prescription, who then place the prescription in front of all other prescriptions waiting to be picked. Once the prescription was picked it was prioritised to the front of the queue of prescriptions waiting to be checked and labelled. Once the prescription was checked and labelled it was handed directly to the server who prioritizes the prescription before all the other prescriptions waiting to be dispensed.

To investigate the time benefit derived from being prioritised, the secondary waiting and service times for the priority patients were calculated. Of the total of 125 priority prescriptions recorded for the research period, 21 prescriptions were detailed investigations. Of the 21 detailed investigations, 13 were used to determine the secondary waiting and service times for the priority patients, while eight prescriptions were excluded to eliminate the non-system effect of prescriptions set aside. Ten of the 13 prescriptions included in the determination of secondary waiting and service times were for the priority category: Schedule 6, one prescription was for the priority category: disable and 2 were for the priority category: radiotherapy. The average waiting time calculated for the different categories of priority patients are tabulated in Table 12 and summarised as follows:

- 00:47:04 for all the thirteen priority prescriptions.
- 00:27:31 for only the prescriptions for the deaf and the radiotherapy patients.
- 01:01:24 for only the ten Schedule 6 prescriptions.

The difference in the waiting time of 00:33:53 between the Schedule 6 and the disable and radiotherapy priority categories notably occurred during waiting time 3, then time during which schedule 6 prescriptions are sent to the schedule room for preparation.

The quantitative methodology together with the qualitative observation provided valuable information on priority patients at the SBAH outpatient pharmacy. The limitation of the research was the small number of priority prescriptions used in the calculation of the secondary waiting and service times for priority prescriptions.

Table 12: Secondary waiting and service times for the priority patients

From the detailed investigations	Waiting time 1: waiting time before a prescription was picked	Waiting time 2: waiting time before a prescription was checked and labelled	Waiting time 3: waiting time before a prescription was dispensed	Total waiting time for a prescription in the queue	Service time 1: service time to pick a prescription	Service time 2: service time to check and label a prescription	Service time 3: service time to dispense a prescription	Total service time for a prescription	Total waiting time for a prescription in the system
Sample waiting time	00:29:52	00:15:30	00:13:59	00:59:15	00:02:47	00:03:34	00:01:33	00:07:54	01:07:15
Waiting time for thirteen priority prescriptions	00:07:50	00:10:03	00:20:16	00:38:08	00:03:00	00:04:23	00:01:33	00:08:55	00:47:04
Waiting time from for the ten S6 priority prescriptions	00:11:30	00:11:24	00:29:51	00:52:45	00:02:06	00:05:00	00:01:33	00:08:39	01:01:24
Waiting times the deaf and 2 radiotherapy priority prescriptions (n=3)	00:03:20	00:12:00	00:05:38	00:20:58	00:03:00	00:02:00	00:01:33	00:06:33	00:27:31

5.5 Results pertaining to objective 4: To determine the average number of line items prescribed per prescription at the SBAH

The arrival rate, the inter-arrival times and the number of line items prescribed per prescription all contribute towards the demands made on pharmaceutical services. For the purpose of the research each medication prescribed on a prescription was referred to as a line item or an item. The number of line items prescribed per prescription is often used as an indirect indicator for monitoring the rational prescribing by doctors within the public health care sector (MSH 1997).

Using 412 detailed investigations from the sample population the average number of line items prescribed per prescription was calculated as 5 line items per prescription and shown in Table 13.

Table 13: The average number of line items prescribed per prescription

	The average number of line items per prescription				
	Fri	Mon	Tues	Wed	Thurs
Average number of line items per prescription per day	5	6	5	5	5
Average number of line items per prescription for the research period	5				

An average 5 line items were prescribed per prescription at the SBAH outpatient pharmacy. For a better understanding of the range of line items prescribed per prescription, a prescription analysis was performed using 413 detailed investigations from the sample population and the results are tabulated in Table 14.

Table 14: The number of prescriptions with the different number of line items prescribed

Number of line items prescribed per prescription	Number of prescriptions					
	Fri	Mon	Tues	Wed	Thurs	Totals
1	15	9	11	17	17	69
2	19	10	8	14	9	60
3	16	10	14	17	14	71
4	4	9	12	6	5	36
5	11	7	7	8	4	37
6	6	4	3	1	7	21
7	3	4	8	2	9	26
8	4	5	5	2	7	23
9	4	5	0	5	4	18
10	3	5	2	2	4	16
11	4	1	2	2	3	12
12	1	1	1	1	1	5
13	2	2		1	1	6
14	0	1		3		4
15			1	1	1	3
16		1				1
17		1				1
20	1					1
21				1	1	2
24					1	1

The prescription analysis highlighted that:

- Sixty nine (17%) prescriptions had one line item prescribed.
- Sixty prescriptions (15%) had two line items prescribed.
- Seventy one (17%) prescriptions had three line items prescribed.
- Thirty six (9%) prescriptions had 4 line items prescribed.
- Thirty seven (9%) prescriptions had five line items prescribed.
- The highest number of line items prescribed for a prescription was 24.

The research provided an opportunity to confirm a commonly used capacity planning norm of unknown origin, which states that it should takes approximately one minute to prepare a

line item on a prescription. To validate this norm the average service time to prepare an item per prescription at the SBAH outpatient pharmacy was calculated as shown in Table 15.

Table 15: The average service time to prepare a line item per prescription

A: Number of line items prescribed per prescription	B: Total service time required to prepare and dispense an uncomplicated prescription	C: Total service time required to prepare and dispense a line item per prescription (B/A)
1	00:04:51	00:04:51
2	00:04:51	00:02:25
3	00:05:59	00:02:00
4	00:06:10	00:01:33
5	00:08:19	00:01:40
6	00:06:52	00:01:09
7	00:07:11	00:01:02
8	00:07:49	00:00:59
9	00:08:58	00:01:00
10	00:11:13	00:01:07
11	00:10:33	00:00:58
Average		00:01:42

All “uncomplicated” prescriptions, that is, prescriptions which did not require an item to be packed, did not have an item out of stock and showed no errors were separated out from the sample population. The service time to prepare and dispense a line item per prescription was derived by dividing the total service time required to prepare and dispense an uncomplicated prescription by the number of line items prescribed for that prescription as shown in Table 15. The average time to prepare a single line item on an uncomplicated prescription, at the SBAH outpatient pharmacy was 00:01:42. It is only for prescriptions with six line items or more that the mentioned norm of one minute per line item, applied. The limitation of the simplistic methodology used to calculate the time taken to prepare a line item per prescription may be flawed in that it did not investigate if the prescriptions complied with the qualitative aspects of the dispensing process as required by legislation (SAPC 2008). Nevertheless it provides a qualitative estimate that could be used in capacity

planning to meet the demand for pharmaceutical services at the SBAH outpatient pharmacy.

5.6 Results pertaining to objective 5: To theoretically determine the number of prescriptions that could be down referred to the primary level of care for clinical management.

The appropriate utilization of tertiary health care services ensures that specialist care is available at all times to those who need it in a cost-effective manner. The appropriate utilization of tertiary services by the sample population was determined by reviewing the line items prescribed on a prescription without any consideration of the patient's clinical condition or other needs. If all items prescribed on a prescription were listed in the primary health care essential drug list (DOH 2003), the prescription was theoretically classified as being down referable. If any one item on the prescription did not appear on the primary health care essential drug list (DOH 2003), the prescription was categorised as not being down referable. The results are shown in Table 16 and Table 17.

Table 16: The number of prescriptions that could be down referred

	Total number of prescriptions that could theoretically be down referred				
	Fri	Mon	Tues	Wed	Thurs
Actual number of prescriptions that could theoretically be down referred	10	13	22	20	8
Total number of prescriptions that could theoretically be down referred for the research period	73				
Average number of prescriptions that could theoretically be down referred per day	15				

Table 17: The number of prescriptions that cannot be down referred

	Total number of prescriptions that could theoretically not be the down referred				
	Fri	Mon	Tues	Wed	Thurs
Actual number of prescription that could theoretically not be down referred	68	70	59	80	79
Totals number of prescriptions that could theoretically not be down referred for the research period	356				
Average number of prescriptions that could theoretically not be down referred per day	71				

A total of 429 detailed investigations were used to theoretically determine the appropriate utilization of tertiary services. A total of 73 (17%) detailed investigations were found to be down referable to lower levels of care and a total of 356 (83%) prescriptions had items prescribed that were considered specialist drugs and for use only at the tertiary level of care. The methodology employed assisted in determining estimates for the appropriate utilization of tertiary services by the patients seen at the SBAH outpatient pharmacy.

The inappropriate utilization of service affects the demand for pharmaceutical service and a better understanding of the extent of the inappropriate utilization of tertiary services, contributed towards the demand management strategies.

5.7 Results pertaining to objective 6: To determine the average number of medications requiring packing and the additional time required to pack an item during the dispensing process at the SBAH outpatient pharmacy

The availability of medication in patient-ready packs facilitated the dispensing of the prescriptions. Make-to-order prescriptions generally require additional time during the dispensing process, negatively affecting waiting times. The research objective required that both the number of items requiring packing during the dispensing process and the additional time required for the packing process be determined.

At the SBAH outpatient pharmacy the average number of items requiring packing during the dispensing process is shown in Table 18.

Table 18: Number of items requiring packing during the dispensing process

	Total number of items requiring packing during the picking process				
Time interval	Fri	Mon	Tues	Wed	Thurs
Actual number of items packed per day	46	39	34	34	24
Totals number of items packed during the research period	177				
Average number of items requiring packing per day	35				

The total number of items that required packing during the dispensing process for the research period was 177 averaging to 35 items per day. The highest number of items packed during the dispensing process was 46 on Friday and the lowest was 24 on Thursday.

The average additional service time required to pack an item during the dispensing process is shown in Table 19. The average additional service time required to pack an item during the dispensing process is the difference between the total service times to prepare uncomplicated prescriptions, and the total service time to prepare prescriptions requiring one item to be packed during the dispensing process. The average additional time of 00:02:03 was fully attributed to the item requiring packing during the dispensing process. The longest additional time required to pack an item during the dispensing process was 00:08:35 while the shortest time required was (00:00:05). On average 35 items required packing per day, implying that a total of 01:11:45 of the daily man hours was spent performing this task.

Quantifying the number of items requiring packing and the average additional time required to pack an item during the dispensing process improved the understanding of how this activity influences the capacity planning process to meet the demand made on pharmaceutical services.

Table 19: The average additional time required to pack an item during the dispensing process

A: Number of items prescribed per prescription	B: Total service time required to prepare an uncomplicated prescription	C: Total service time required to prepare a prescription with one item to be packed	D: Additional service time required to prepare a prescription with one item to be packed (C-B)
1	00:04:51	00:04:46	(00:00:05)
2	00:04:51	00:04:51	00:00:00
3	00:05:59	00:08:13	00:02:14
4	00:06:10	00:08:03	00:01:53
5	00:08:19	00:07:33	(00:00:46)
6	00:06:52	00:08:33	00:01:41
7	00:07:11	00:12:03	00:04:52
8	00:07:49	00:09:33	00:01:44
9	00:08:58	00:17:33	00:08:35
10	00:11:13	00:10:41	(00:00:32)
11	00:10:33	00:09:33	(00:01:00)
Average			00:02:03

5.8 Results pertaining to objective 7: To determine the number of prescriptions with an item out of stock and the additional time required to manage an out of stock situation at the SBAH outpatient pharmacy

The requirement of this objective was to determine the number of prescriptions with an item out of stock and the additional time required to process the prescription.

Table 20 shows that a total of 40 items on 39 prescriptions were out of stock for the research period, averaging to 8 items per day. Only one item was out of stock on Monday and 19 items on Thursday. Seventy seven percent of all out of stock situations occurred on Wednesday and Thursday.

Table 20: The number of items out of stock

	Total number of items marked out of stock on prescription				
Time interval	Fri	Mon	Tues	Wed	Thurs
Totals for the day	3	1	5	12	19
Actual number of items out of stock for the research period	40				
Number of prescription which had an out of stock reported	39				
Average number of items out of stock per day	8				

To quantifying the additional time to manage a prescription with an item out of stock was determined using a methodology similar to that for determining the additional time required to pack an item. The results are shown in Table 21.

Table 21: The average additional time required to manage an item out of stock

A: Number of line items prescribed per prescription	B: Total service time required to prepare an uncomplicated prescription	C: Total service time required to prepare a prescription with one item out of stock	D: Additional time required to prepare a prescription with one out of stock item (C-B)
1	00:04:51		
2	00:04:51	00:06:33	00:01:42
3	00:05:59	00:03:33	(00:01:26)
4	00:06:10	00:05:33	(00:00:37)
5	00:08:19	00:06:33	(00:01:46)
6	00:06:52	00:07:53	00:01:01
7	00:07:11	00:06:33	(00:00:38)
8	00:07:49	00:07:33	(00:00:16)
9	00:08:58	00:07:33	(00:01:25)
11	00:10:33	00:14:33	00:04:00
The average additional time to manage an item out of stock			00:00:04

The additional time required to process a prescription with an item out of stock was 00:00:04. The longest time taken to deal with an item out of stock was 00:04:00 and the

shortest time was (00:01:46). The finding highlights that the time taken to manage an item out of stock was almost the same as if the item was available for dispensing.

5.9 Results pertaining to objective 8: To determine the service rate, the service distribution and the average number of servers serving the patients at the SBAH outpatient pharmacy

The supply of pharmaceutical services is a labour intensive process and is highly dependent on the availability of pharmacists and pharmacist assistants. Information from the 30 minute observation using Annexure 4 was used to investigate the number of servers serving the patients, and the number of staff members involved in the multiphase dispensing process. The documented dispensing time was used to determine the service rate per 30 minutes time interval, and the service time distribution.

The average number of staff members involved in the various dispensing functions are shown in Table 22.

Table 22: The number of staff members involved in the dispensing process

Day of week	Number of staff members picking prescriptions	Number of staff members checking / labelling prescriptions	Number of staff members dispensing prescriptions
Fri	2	3	1
Mon	3	4	1
Tues	4	4	1
Wed	4	4	1
Thurs	4	5	2
Average staff involved per day for the various dispensing processes.	3	4	1
Total average staff complement per day	8		

On average 3 staff members were continuously involved in the picking process, 4 in the checking and labelling process and only 1 was involved in serving the patients. On average 8 staff members were continuously involved in the dispensing process throughout the day. On Thursday a maximum of 11 staff members were involved in the dispensing process while only 6 were involved on Friday.

Table 23 shows that 39% of the total SBAH pharmacy staff establishment of the SBAH pharmacy was allocated to the outpatient pharmacy.

Table 23: The staff establishment for the SBAH pharmacy

Staffing	Total pharmacy staff establishment	Staff allocated to outpatient pharmacy	Actual staff members present at the outpatient pharmacy
Pharmacy managers	6	1	1
Pharmacist	9	5	4
Pharmacy interns	4	1	0
Qualified post basic pharmacist assistants	11	4	3
Qualified basic level pharmacist assistants	10	4	3
Learner basic level pharmacist assistants	1	1	1
Totals	41	16	12
% of totals		39%	29%
Queue Marshal	1	1	1

During the research period only 12 (29%) of the allocated personnel were physically present at the outpatient pharmacy. During tea (9h30-10h30) and lunch (12h30-13h30) the average number of personnel involved in the dispensing process remained constant at 8.

The 30 minute observation also provided information on the number of prescriptions that waiting during the multiphase dispensing process and the number of prescriptions being serviced at any point in time as shown in Table 24.

Table 24: Number of prescription being served or waiting to be served

Number of prescriptions waiting to be picked	Number of prescriptions being picked	Number of staff members picking	Number of prescription waiting to be checked and labelled	Number of prescription being checked	Number of staff members checking and labelling	Number of prescription waiting to be dispensed	Number of prescription being dispensed	Number of staff members dispensing
23	3	3	13	4	4	5	1	1

At any point in time, an average of 23 prescriptions waited for service to begin while 18 prescriptions were partially serviced, waiting for the next phase of the dispensing process to begin, and a total of 8 prescriptions were being served by 8 staff members.

Consistency and the reliability of service require a service norm against which performance could be measured. The service rate, and the service time are important norms that provide input for the capacity planning process. The average service rate, which is the total number of prescriptions serviced per day, is shown in Table 25.

Table 25: Average service rate

Average service rate per 30minute time interval					
Time interval	Fri	Mon	Tues	Wed	Thurs
Total service rate for the day	270	413	480	462	521
Total patient serviced for the research period	2146				
Average number of patients serviced per day	429				

On average 2146 prescriptions were serviced for the research period averaging to 429 per day and 24 per 30 minute time interval. Table 26 shows that 99.5% of the daily arrivals were serviced on the same day.

Table 26: The average daily arrival and service rate

	Average arrival rate per day	Average service rate per day
Fri	275	270
Mon	435	413
Tues	456	480
Wed	465	462
Thurs	523	521
Average	431	429

The utilization rate derived from the queue theory was the arrival rate divided by the service rate multiplied by the number of servers. For the SBAH outpatient pharmacy the utilization rate for all the days of the research was computed as 99.5%. Stevenson (1989) states that any system with a utilization rate equal to or greater than one, is regarded as a highly loaded queue system and it is interesting to note that, for both the least busy and the busiest day of the week the utilization factor was approximately one.

The service time, another measure against which reliability and consistency of service can be measured equals the average time required to pick, check and label and dispense a prescription. The service time of 00:07:54, for the sample population was computed during the investigation of the secondary waiting and service times as shown in Table 5. Consistency and reliability required the establishment of a range of service times that occurred with the highest frequency therefore, a prescription analysis was performed using the service time from the 422 detailed investigations, and the results are shown in Table 27.

Table 27: The service time distribution

Total average service time to prepare a prescription	Fri	Mon	Tues	Wed	Thurs	Total number of prescriptions	Percentage (%) of total prescriptions (n=408)
00:01:33	1					1	0%
00:02:33	2	2			0	4	1%
00:03:33	10	9	11	17	9	56	14%
00:04:33	16	7	10	24	15	72	18%
00:05:33	11	9	12	11	10	53	13%
00:06:33	8	6	7	4	12	37	9%
00:07:33	6	4	8	4	11	33	8%
00:08:33	7	4	7	7	10	35	9%
00:09:33	8	7	5	3	3	26	6%
00:10:33	6	3	3	7	4	23	6%
00:11:33		9	1		1	11	3%
00:12:33	4	4	4		1	13	3%
00:13:33	5	3	1		1	10	2%
00:14:33	4	0	4		5	13	3%
00:15:33	2	1			1	4	1%
00:16:33			1	1	1	3	1%
00:17:33		2	1			3	1%
00:18:33	1					1	0%
00:19:33		1				1	0%

The most frequently occurring service time was 00:04:33. Seventy two prescriptions required 00:04:33 to be serviced, fifty six prescriptions required 00:03:33 to be serviced and a total of 291 (72%) of prescriptions were services between 00:01:33 and 00:08:33. The shortest service time was 00:01:33 and the longest service time was 00:19:33.

The research clearly demonstrated the ability to collect both the service time and the service rate as required by the research objective.

5.10 Results pertaining to objective 9: To determine the average number of errors made during the dispensing process and the additional time required to rectify an error at the SBAH outpatient pharmacy

Quantifying the types of errors made and the additional time required to rectify errors during the dispensing process, are important measures of rational dispensing and pharmaceutical care.

Errors introduce variability during the service and must be monitored to ensure quality service of care. Four hundred and sixty seven detailed investigations were used to evaluate the error rate and the types of errors made during the research as shown in Table 28.

Table 28: The types of errors made during the dispensing process

Incorrect item picked during the picking process	Incorrect quantity picked during the picking process	Item not picked during the picking process
12 (18%)	34 (52%)	20 (30%)

A total of 66 errors were made on 62 prescriptions. Fifty two percent of errors occurred due to the incorrect quantity of medication being picked followed by 30% of errors for items not picked or omitted during the picking process and 18% of errors were due to an incorrect item being picked.

This objective also required the determination of the average additional time taken to rectify a prescription with an error. The average additional time to rectify an error was calculated using a methodology similar to that of the determining the average additional time to pack an item and for managing an item out of stock; the results are shown in Table 29. The average additional time to rectify an error on a prescription was calculated as 00:03:09. On average the total additional time required to rectify 13 errors per day was 00:40:57. The maximum time taken to rectify an error was 00:05:08 and the shortest time taken to rectify an error on the prescription was (00:00:05).

Table 29: The average additional time required to correct an error on the prescriptions

Number of items prescribed per prescription	A: Total service time required to prepare an uncomplicated prescription	B: Total service time required to prepare a prescription with one error	Additional time required to prepare a prescription with one error (B-C)
1	00:04:51	00:08:13	00:03:22
2	00:04:51	00:05:03	00:00:12
3	00:05:59	00:08:18	00:02:19
4	00:06:10	00:11:18	00:05:08
5	00:08:19	00:08:13	(00:00:05)
6	00:06:52	00:09:33	00:02:41
7	00:07:11	00:11:43	00:04:32
8	00:07:49	00:12:33	00:04:44
9	00:08:58		
10	00:11:13	00:11:33	00:00:20
11	00:10:33	00:15:33	00:05:00
Average time taken to prepare a prescription with one error			00:03:09

The general assumption made by many pharmacists, that the greater the number of items prescribed per prescription, the greater the risk of errors being made. To validate this assumption a prescription analysis was conducted using 62 prescriptions with errors which were categorised into the different number of items prescribed per prescriptions as shown in Table 30. The greatest number of errors occurred on prescriptions with 7 items prescribed, followed by prescriptions with 3 items prescribed. Prescriptions with 1, 15 and 16 line items had no errors.

The scope of the research was able to quantify the error rate and identify the most common type of errors; however, the scope of the research did not include an analysis of the cause of errors.

Table 30: Prescriptions with errors versus the number of line items prescribed

Number of line items per prescription	Number of prescriptions with errors	Number of line items per prescription	Number of prescriptions with errors
1	6	11	5
2	3	12	1
3	8	13	1
4	5	14	2
5	4	15	0
6	3	16	0
7	11	17	1
8	4	21	1
9	3	24	1
10	3		

5.11 Results pertaining to objective 10: To observe the workflow, layout, attitude of staff and other interruptions affecting the supply of pharmaceutical services at the SBAH outpatient pharmacy

The narrative of the qualitative analysis of the research will be presented in the sequence of the dispensing process where layout, workflow and process issues will be discussed. The sketch of the layout of the SBAH outpatient waiting area and pharmacy are shown in Annexure 6 and 7 respectively.

The arrival of patients at the outpatient pharmacy remained random even though there was an appointment system at the registry department. The main aim of the appointment system at registry was to ensure that all patients' files were retrieved from archives a day before the appointment date, to improve efficiencies at the registry department. The appointment system monitors the date the patient arrived but not the arrival times.

The dispensing process at the outpatient pharmacy began when the patient handed in the prescription to the queue marshal who in turn tagged the prescriptions with an electronically generated patient number and prioritized the prescription, if so required.

Observation revealed that the queue marshal sat awkwardly, with the electronic patient generating machine, her workstation, situated on a table on her right hand side. The queue marshal did not face her workstation. Two chairs situated outside all seven serving windows obstructed easy access and communication with the staff inside the pharmacy especially, since these chairs were used by waiting patients.

The purpose of the electronic patient number generating machine was to electronically monitor the arrival rates of patients at the outpatient pharmacy. The queue marshal was tasked with the responsibility of issuing the electronic patient number; however, between 7h00 and 7h30 and during tea and lunch time, the queue marshal was not on duty and the electronic patient numbers were not issued. For the research period the researcher served as a relief for the queue marshal whenever required. During the pilot phase of the research it was discovered that the timing on the electronic patient number generating machine was incorrect, lengthening the waiting times by approximately ten minutes. Subsequently this was corrected and checked daily. Another anomaly observed was that the queue marshal printed many electronic patient numbers simultaneously in preparedness for the next patient arrival without realizing that the practice lends itself to lengthening the patients' waiting time.

The prescriptions handed in at the pharmacy were stacked on a table in order of arrival. The first-in-first-served principle was applied with the exception of the priority prescriptions which proceeded to the beginning of the queue of waiting files. File management within the pharmacy was required as patients often handed in more than one file with many loose documents, while other patients hand in single page prescriptions. The single page prescription, were sometimes missed during the dispensing process because they were mistakenly placed within other patients files. Within the patients file, the current prescription was not always easily retrievable and additional time was required to search for the prescription before dispensing proceeded. The working surface area for picking of prescriptions seemed adequate for the workload.

The basic level pharmacist assistants who picked the prescription were efficient in that the same medication shelf was never visited twice. Picking was done from shelves on both side of the aisle. The concern with the picking process was that the packing of medication during the dispensing process was not always supervised by a pharmacist.

The picked prescriptions were placed in brazier bins and set aside on a designated table for checking and labelling. Prescriptions awaiting checking and labelling were not always in the exact order of arrivals, and slips and skips occurred due to the variability introduced by the different number of items per prescription, the packing of items during the dispensing process, errors and out of stock situation. Staff members checking and labelling the medication took on average three prescriptions to their workstations for checking and labelling. Occasionally an error or an out of stock situation on one prescription delayed the checking and labelling of the other prescriptions taken, adding to the slips and skips within the dispensing process. There were sufficient designated work stations for all staff checking and labelling prescriptions.

Prescriptions checked and labelled by the pharmacist or post basic pharmacist assistant, were subsequently set aside at either windows three or four for dispensing. The space to store the items awaiting the final phase of dispensing was totally inadequate. Both windows had a total capacity to store an approximate 20 prescriptions which was inadequate during the busiest time of the day, namely 11h00 until 13h30. Often prescription boxes were stacked on top of one another resulting in the non-adherence to the first-in-first-out principle. The skips and slips inherent in the dispensing process were further exacerbated during the final stages of the dispensing process.

Confidentiality, a requirement of the final dispensing process was totally disregarded during the dispensing process. The inappropriately positioned seats in front of the serving windows were always occupied by waiting patients and this contravened the right to privacy and confidentiality of patients receiving their medication. The height of the serving window required that both the server and the patients be seated during the final dispensing process. Since neither the server not the patients sat during the dispensing process, both

parties had to bend downward to effectively communicate effectively during dispensing. This impeded effective communication between the server and the patient. The level of counselling provided to patients was only label reinforcement, where patients were only instructed on the use of their medication.

At the end of the dispensing process the patient's usually bulky medical files were retained in the pharmacy, and were collected the next morning by personnel from the registry department. In the pharmacy the files were stacked neatly on the floor in the vicinity of windows three and four, often obstructing staff movement, especially on Thursday the busiest day of the week. Occasionally patients returned to collect their medical files for various reasons and the pharmacy personnel responsible for the picking of the prescription were assigned with the task with finding the medical file, which could take approximately 5 to 15 minutes to find. Issuing of prescriptions set aside, dealing with patients' queries, and issuing of previously unavailable medication are all time consuming task which are also assigned to the personnel picking the prescription.

5.11.1 Attitude of staff

All staff at the outpatient pharmacy displayed a courteous and friendly attitude towards the patients. Staff dispensing assisted with checking and labelling if required and staff checking and labelling assisted with picking during an influx of prescriptions into the pharmacy. Under the circumstances of great work pressure, the atmosphere within the outpatient pharmacy was pleasant. Patients were always called to collect their medication using a combination of the computer generated number followed by the full name and surname of the patient, as this was considered courteous. Patients were addressed mainly in Afrikaans, the predominantly spoken language in Tshwane. The qualified post basic pharmacist assistants involved in dispensing had the ability to address patients in either Zulu or Sotho, if so required.

5.11.2 Procurement of stock from the pharmacy stores

One basic level pharmacist assistant was assigned on a monthly rotational basis to the procurement of stock and other logistical issues. Orders were placed with the pharmacy store on Tuesday and Thursdays and stock was received on Wednesday and Fridays. Unpacking of the received stocks occurred throughout the week. The basic level pharmacist assistant assigned to procurement functions, assisted with the dispensing process during tea and lunch times and during busy periods.

5.11.3 Other observations

The following observations were made:

- All staff arrived on time to work.
- No abuse of tea and lunch times, strict discipline was displayed by all staff.
- None of the staff members used cell phones during normal working hours.
- A maximum number of 5 telephone calls were received at the outpatient pharmacy all of which were answered by either the pharmacist or the post basic pharmacist assistants responsible for checking and labelling.

The qualitative analysis of the research provided valuable insight which was used to make recommendations to improve services at the SBAH outpatient pharmacy.

CHAPTER 6: DISCUSSION OF THE RESULTS

The findings will be discussed under the objectives identified for the research and the interrelatedness between the findings of the different objectives will be discussed where most appropriate.

6.1 Objective 1: To compare and validate the GDH average waiting time with the average waiting time from the research

The aim of this objective was to calculate the objective waiting time for the patients at the SBAH outpatient pharmacy and to use the objective waiting time to validate the monthly waiting times computed by the GHD Quality Assurance Department, to build confidence in the routine system used. The various waiting times computed for the research, as shown in Table 5 are graphically represented in Figure 8.

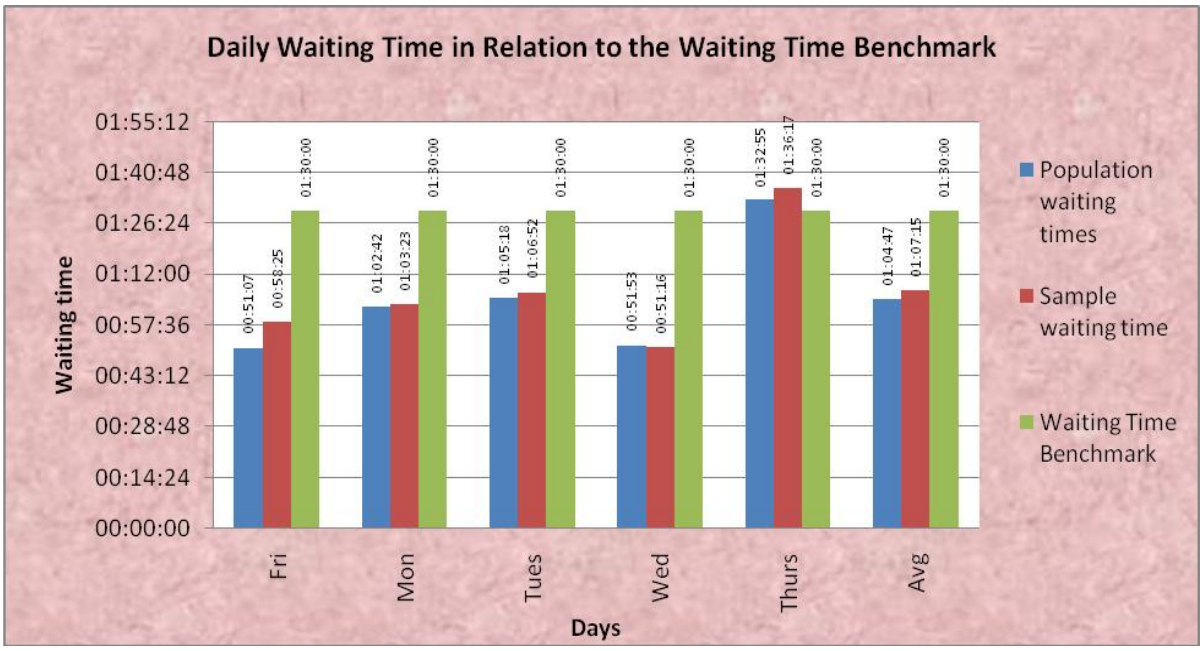


Figure 8: The waiting times of patients in relation to the waiting time benchmark

The population waiting time from the research was computed as 01:04:47, 00:02:28 shorter than the sample waiting time of 01:07:15. The waiting time from the GDH Quality

assurance Department of 01:05:00 as compared to the waiting times of this research is as follows:

- 00:00:13 longer than the average population waiting time of 01:04:47.
- 00:02:15 shorter than the average sample waiting time of 00:07:15.

The waiting times calculated during the research and that obtained from the GHD Quality Assurance Department were not significantly different, despite the fact that the research used a much larger random sample of 467 prescriptions versus the maximum of 20 prescriptions usually used by the GDH Quality Assurance Department.

The 01:30:00 benchmark or waiting time guarantee set by the SBAH outpatient pharmacy was:

- 00:25:13 more than the population waiting time of 01:04:47.
- 00:22:45 more than the sample waiting time of 01:07:15.

At a glance it may appear that SBAH was delivering on its promise as the population and sample waiting time were much shorter than the 90 minute benchmark set. However, a total of 452 (21%) prescriptions from the research population waited longer than the average benchmark of 90 minutes and 784 (36%) of prescriptions waited longer than the average population waiting time of 01:07:15, as shown in Table 4. On Thursday, the busiest day of the week, an approximate 39% of prescriptions waited longer than the 90 minute benchmark while approximately 78% of prescription waited longer than the population waiting times. Of the total population for the research, 109 (5%) patients wait longer than 2 hours, 38 (2%) patients wait longer than 3 hours and one patient waited longer than 8 hours, longer than the normal working hours of the outpatient pharmacy. A possible explanation would be that the patient generated his/her own electronic number well before the start of business at the outpatient pharmacy, since the electronic generating machine is situated in the patient waiting area.

The GDH Quality Assurance Department had not identified nor adjusted their waiting times for the prescriptions set aside. The average time lapse before patients collected their

prescriptions set aside was computed as 00:50:28 which is the difference between the population waiting time of 01:04:47 and the average waiting time for only the prescriptions set aside of 01:55:15, from section 5.2.3. Being unaware of the occurrence of prescriptions being set aside, the increase in waiting time three, by approximately 00:50:28 can be erroneously attributed to internal pharmacy delays within the final dispensing process of the prescription when in actual fact, the delay was due to an external variable, the patient's choice to delay the collection of their medication. A difference of only 00:05:55 was seen when the population waiting time was compared to the population waiting time as adjusted for prescriptions set aside. The probable explanation being that, the additional time lapse of 00:50:28 for each of the 90 prescriptions set aside was buffered by the large sample size used in the calculation of the average population waiting time as adjusted for the prescriptions set aside. However, the inclusion of prescriptions set aside into the GDH monthly waiting times monitoring system , may not provide the buffer required, distorting or overstating the waiting times of patients at the SBAH outpatient pharmacy. The population waiting time as adjusted for the prescriptions set aside, of 00:58:52, can be considered the true waiting time for the SBAH outpatient as the non-system issue, "the patient's choice to delay the collection of their medication", has been eliminated from the average population waiting time calculation. All future interventions must acknowledge the negative effect of this non-system issue on waiting time. Prescriptions set aside must be managed proactively, especially if this practice increases.

The dispensing process described in Figure 5 shows that the dispensing process comprised of many secondary waiting and service times (Fourie *et al.* 2007). The sample waiting time of 01:07:15 in the system comprised of the:

- Total average waiting time in the queue of 00:59:21.
- Total average service time of 00:07:54.

The relationship between the secondary waiting and service times during the dispensing process is graphically shown in Figure 9.

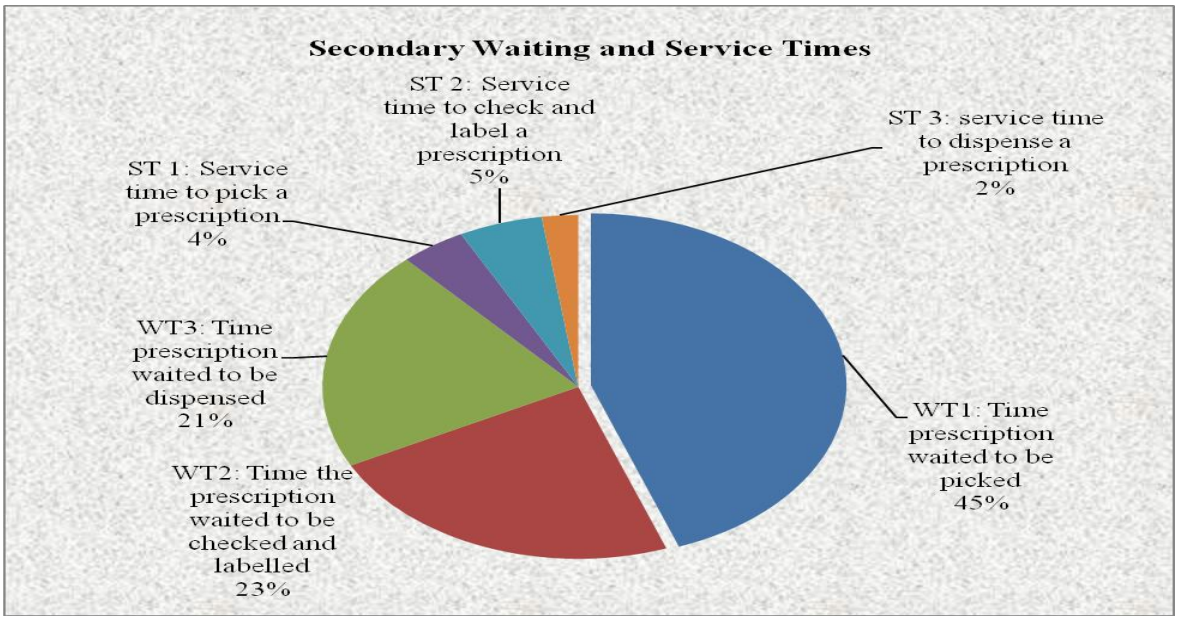


Figure 9: The relationship between the secondary waiting and service times

Figure 9 shows that on average 89% of the sample waiting time was spent waiting for service while only 11% of the sample waiting time was actual service time. Figure 9, shows that waiting time one which is the time the prescription waiting to be picked, was the longest at 00:29:52, almost double that of 00:15:30 for which time the prescription waited to be checked and labelled and double that of 00:13:59 for which the prescription waited to be dispensed.

The service time taken to check and label a prescription was 00:03:34, which was approximately 1.3 times the time required for picking a prescription and 1.5 times the time required to dispense a prescription. Of the total service time of 00:07:54, the actual time the server spent with the patient during dispensing was a minuscule 00:01:33. DiPiro *et al.* (1993) clearly states that the role of the pharmacist must expand to incorporate "pharmaceutical care" which is: "the responsible provision of drug therapy for the purpose of achieving definite outcomes that improves a patient's quality of life". Raynor (1996) defines three levels of interventions as follows:

- Level 1: medicine label reinforcement: involves giving information at the time of dispensing the prescription; the duration of the consult is usually 1-2 minutes to reinforce the directions on the label. Patient feedback is minimal.

- Level 2: medicine consultation: involves giving advice and information at the time of dispensing the prescription. The duration of the consult is up to 10 minutes. This consult includes label reinforcement, the appropriate use of the medication and discussion on the side effects of the medication. Patient feedback is substantial during this consult.
- Level 3: medicine counselling: this is a two-way interaction between the pharmacist and the patient. The counselling session is by appointment and can last for approximately 30 minutes. The counselling explores all aspects of the patient's medication use and compliance. The feedback from the patient is extensive.

The South African Pharmacy Council: Rules relating to the service for which a pharmacist may levy a fee (RSA 2009), a draft document for comments makes recommendation that a face to face consultation for which a pharmacist may levy a fee should not be less than 8 minutes. This can be compared with the level 2 consultation recommended by Raynor (1996).

Kottler and Keller (2006) have also stated that customer delivered value can be positively influenced if the service and the personal value are increased. This implies that pharmacist must become more involved in the pharmaceutical care of patients to ensure rational drug use and compliance by patients which can only occur if additional quality time is spent with the patient during dispensing. Larson (1987) explains that the perception of waiting can be positively influenced by providing feedback to patients about the waiting times and expected delays. The explanation provided is that patients feel more in control with having real time information about the magnitude and reason for the delay and the patients are better able to select a strategy going forward. The finding of the results, interventions planned and implementation processes must be explained to the patients. Similar to that in the private health care sector, the focus within the public sector should not only concentrate on waiting times but include aspects of the patient's experience within the system.

Quantifying the service times required to prepare prescriptions addressed one of the internal factors cited for the long queues at the pharmacy department as described in the case motivation. A service time norm is now available for the SBAH outpatient pharmacy against which consistency and reliability of service can be measured. The monthly average waiting times computed by the GHD quality assurance department has also been verified by the findings of this research, and can be deemed reliable for use in improvement strategies going forward. The current dispensing procedure is where the output of one process is the input of another process. Attempts to decrease any one of the secondary waiting times in isolation will not necessarily decrease the total waiting time in the queue, it may just shift the waiting time to another queue. To decrease waiting times for the outpatient pharmacy queues, all three waiting times will need to be addressed simultaneously.

6.2 Objective 2: To determine the average arrival rate and the inter-arrival distribution for the prescriptions at the SBAH outpatient pharmacy

Forecasting the demands made on pharmaceutical services period-by-period (Pycraft *etal.*2004) is one of the main tasks of operational managers as this allows managers to plan adequate capacity to meet the demands made on such services. The historical, average daily workload figures as shown in Annexure 5 provided an indication of the average number of patients expected per day but not period-by-period. The research methodology used provides an opportunity to evaluate the workload for each 30 minute time interval.

In many operations the outputs of the operations are considered the most appropriate measure; however, in complex operations sometimes the inputs into the operations are considered more appropriate (Pycraft *et al.* 2004). At the SBAH outpatient pharmacy the input into the system represented by the workload of the system was considered to be an appropriate measure for capacity planning. It was not only the number of prescriptions arriving within a specified time period that was considered important but also how quickly prescriptions arrived in relation to each other represented by the inter-arrival times. The

negative exponential distribution of the inter-arrival times as seen in Figure 10 shows that most prescriptions arrive within a short space of time of each other with a few prescriptions arriving with longer time periods between them.

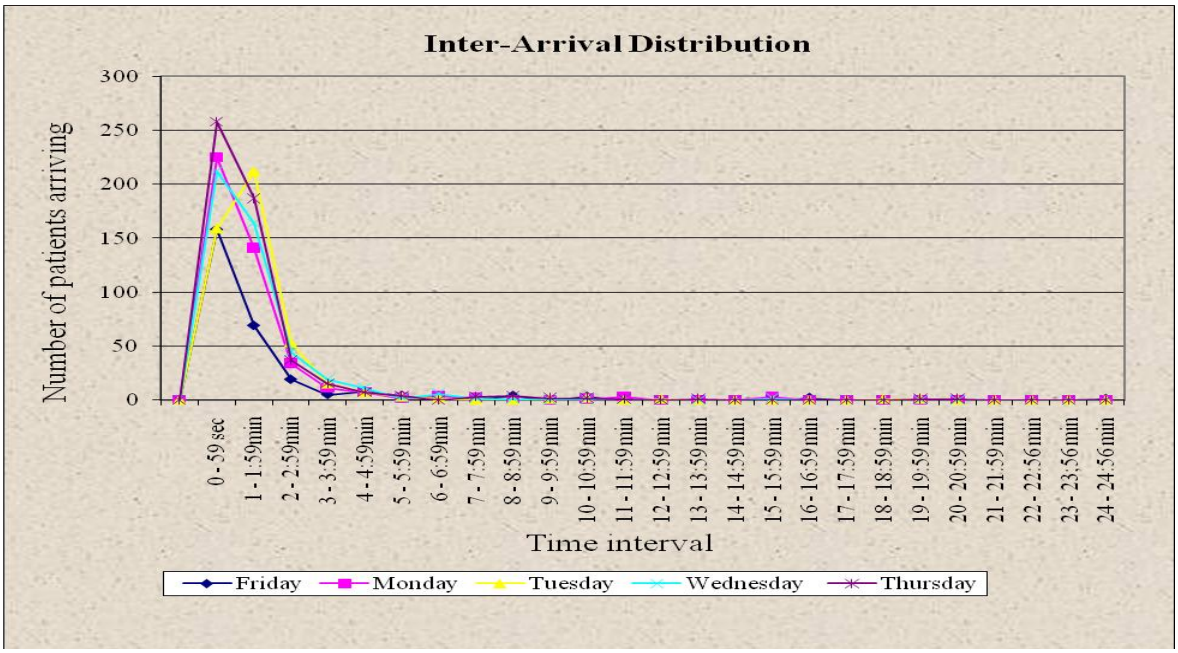


Figure 10: The inter-arrival distribution

Forty seven percent of prescriptions arrived within 0 to 1 minute of each other, 36% of prescriptions arrived within 1 to 2 minutes of each other and a total of 92% of prescriptions arrived within approximately 0 to 3 minutes of each other. The inter-arrival times for 92% of the patients is almost half that of the total service time of 00:07:54, implying a faster arrival rate compared with the service rate. Therefore, it can be expected that patients will always be waiting for service. An appointment system at the SBAH controls the daily number of patients arriving to either consult with the doctor or to collect their repeat medication but was not time specific. The negative exponential distribution of the inter-arrival times of prescriptions confirms that the appointment system at the SBAH does not influence the arrival times of the patients at the outpatient pharmacy, which remained random and unpredictable.

The prescriptions arriving at the SBAH outpatient pharmacy can be separated into the arrivals of acute and repeat prescriptions. The arrival rate of the acute prescription per 30 minute time interval is graphically represented in Figure 11.

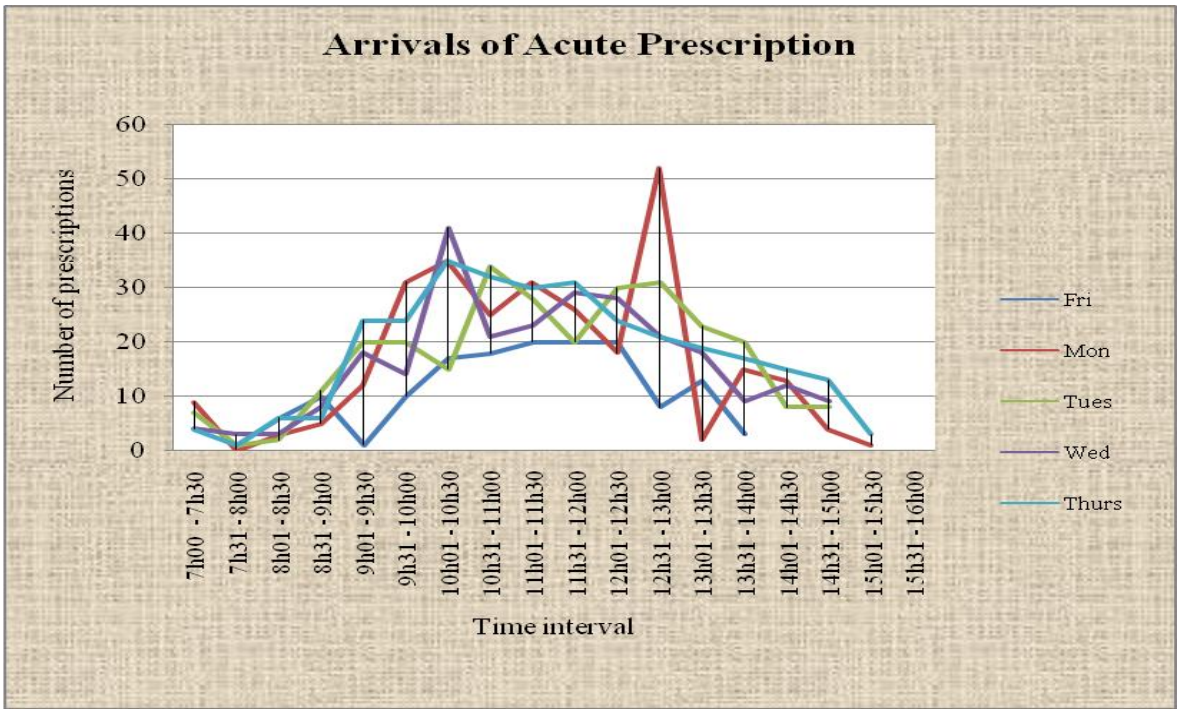


Figure 11: The average arrival rate of acute prescriptions

The arrival rate of the acute prescriptions gradually increases from approximately 8h30 and peak arrival rates occur during the time interval 10h00 until 13h00 with a steady decline thereafter. The arrivals of acute prescriptions cease at approximately 15h00 until 16h00 allowing for the completion of the remainder of the prescriptions received during the day and this trend is clearly visible for all the days of the research.

The arrival rate of the repeat prescription as per the 30 minute time interval is graphically represented in Figure 12.

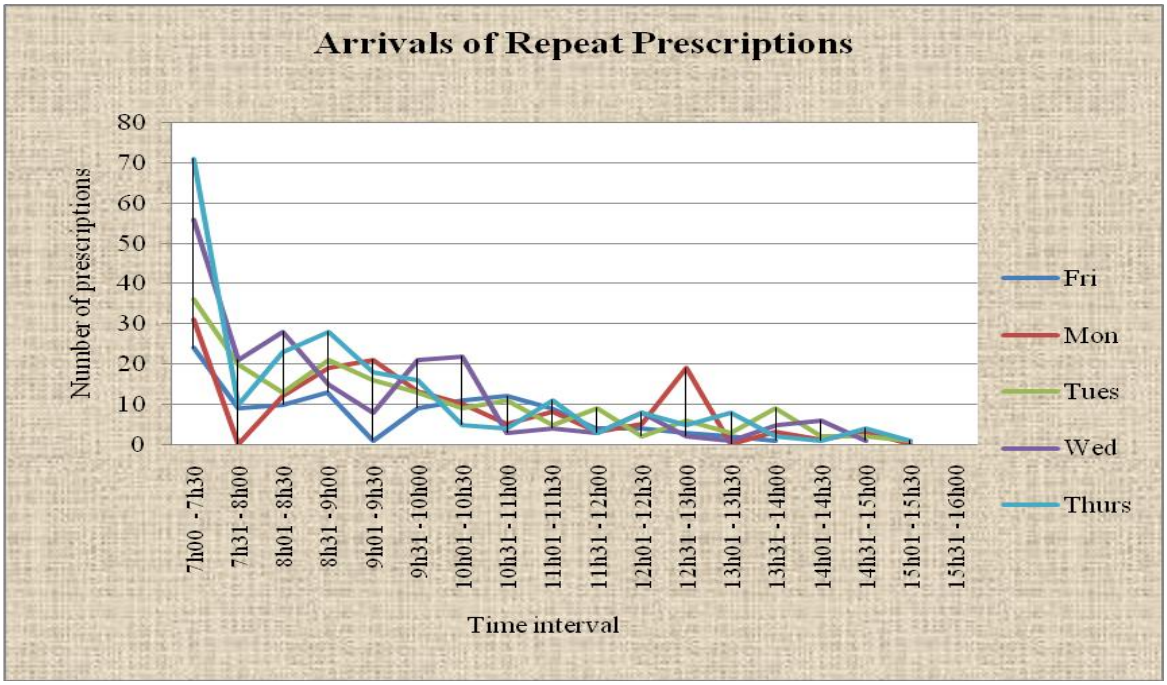


Figure 12: The average arrival rate of repeat prescriptions

Most repeat prescriptions arrive before 7h30 with a second smaller peak in the arrival of repeat prescriptions noticed during the time interval of 8h30 to 9h30. As for the arrival for acute prescriptions, the arrivals of repeat prescriptions cease from approximately 15h00 until 16h00 which allows for the completion of the remainder of prescriptions received during the day. The arrival of repeat prescriptions clearly shows the preference of most patients to arrive early in the morning to collect their medication; however, a consistent number of about 10 repeat prescriptions arrived constantly during each 30 minutes time interval during the day.

The arrival rate of all prescription per 30 minute time interval is graphically represented in Figure 13.

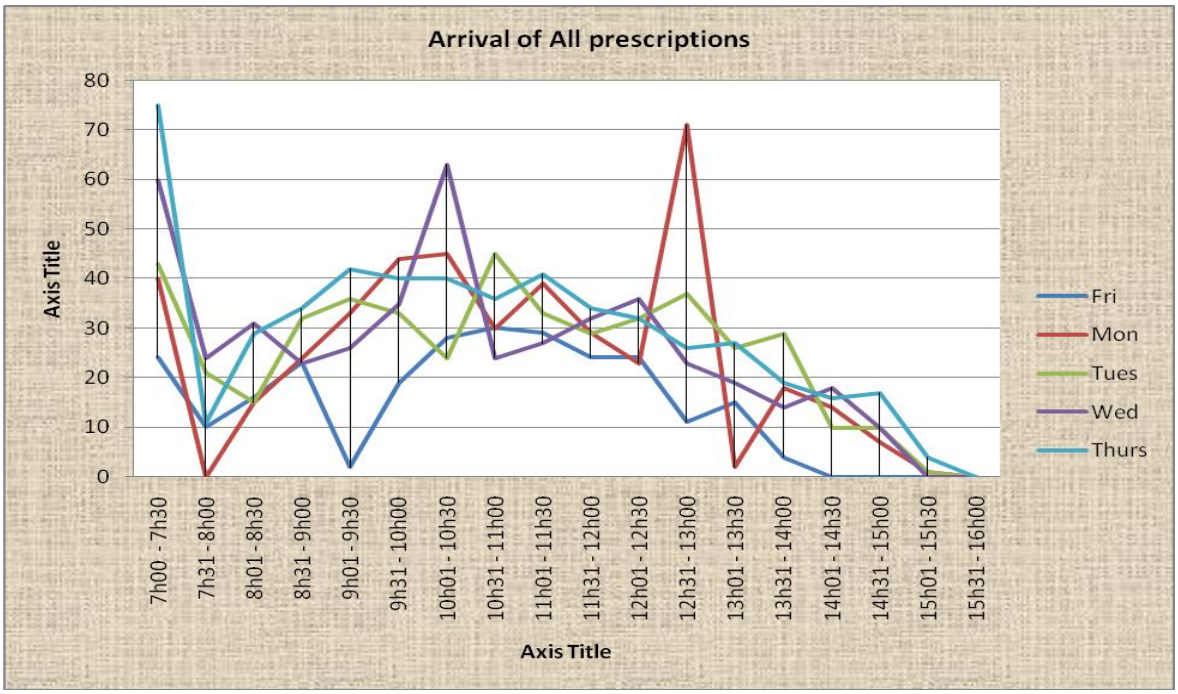


Figure 13: The average arrival rate for all prescriptions

The time intervals between 9h30 and 13h00 show a consistently higher than the average arrival rate of 24 prescriptions per 30 minute time interval. Peak arrivals occur between 10h00 and 10h30 and again between 13h00 and 13h30. These trends are visible for all days of the research period. The visible trends, disproves the concern of pharmacist, as noted in the case motivation, of erratic arrivals of patients during the day. The arrival of patients may appear "erratic" especially if not graphically presented and also if each individual 30minute time interval is compared with other 30 minute time interval in an isolated and unstructured manner.

For an average workload of 431 arrivals per day the expected population waiting time was 01:04:47 and applying a simple linear extrapolation shows that for Thursday, the busiest day of the week with 523 arrivals, the expected waiting time would increase to about 01:18:37. Similarly, a linear extrapolation for Friday, the least busy day of the week with only 275 patients, would indicate a waiting time of 00:40:20. The linear extrapolation demonstrates that when all variables are held constant and only the number of arrivals change, the expected waiting time will change in response to the demands made for pharmaceutical service. The greater the daily workload, the greater the expected average

waiting times, is stating the obvious however; this signifies the importance of demand management strategies to influence waiting times.

Table 22 showed that on Friday, the least busy day of the week, on average only 6 of the 12 staff members allocated to the outpatient pharmacy constantly attended to 275 prescriptions. All 275 prescriptions were served by 14h00 indicating idle time on Friday. The strategy going forward therefore, should be the equalization of the workload during the week, especially shifting some of the repeat workload from Wednesday and Thursday morning to Friday afternoon to minimize the idle time and to ensure a more manageable workload and a more acceptable average waiting time on Thursday.

The peak arrival of acute prescriptions at approximately 10h00 confirms the concern of the pharmacist regarding the late starting times of outpatient clinics. In an effort to optimally utilise the time available in the morning, many GHD pharmacies request their patients to arrive early in the morning to collect their repeat medication before the "usual rush" for the day. A period-by-period analysis of this strategy shows it can unintentionally increase the waiting times of all other prescriptions arriving subsequently. For example the arrival of the 71 repeat prescriptions on a Thursday morning between 7h00 and 7h30, and with a service rate of 24 per 30 minutes time interval, implies that it would take approximately three or four 30minute time intervals to complete the workload of 71 repeat prescriptions, delaying the service of all other prescriptions arriving subsequently to the 4^{th} or 5^{th} 30 minute time interval. The cascading effect of workload to later time periods make "catch up" almost impossible with a constant capacity plan and consequently a strategy of chase-demand has to be implemented on Wednesday and Thursday mornings. This interpretation was only possible after a period-by period analysis of the workload. The above analysis demonstrates how a "rational" decision to optimally utilise the presumably idle time in the morning can in fact aggravate a situation during the day.

The effectiveness of the methodology used in computing period-by period analysis of arrival rates provided valuable additional information which can be used in future improvement strategies regarding demand management.

6.3 Objective 3: To determine the average number of acute, chronic and priority prescriptions seen at the SBAH outpatient pharmacy throughout the day

The output of an operation is dependent on the activity mix, that is, the different types of activities required to complete a task (Pycraft *etal.*2004). The different types of patients seen at the SBAH outpatient pharmacy are for the purposes of this research, described as the activity mix. However, the description of the acute, repeat or priority patients alone does not account for all the variations in the activities of the dispensing process. The number of items per prescription, the additional time required to pack an item during the dispensing process and the additional time required to rectify an error, all add to the activity mix of the prescriptions seen at the SBAH outpatient pharmacy. The activity mix of prescriptions seen at the SBAH outpatient pharmacy comprised 60% acute prescriptions versus 40% repeat prescriptions and this is graphically represented in Figure 14.

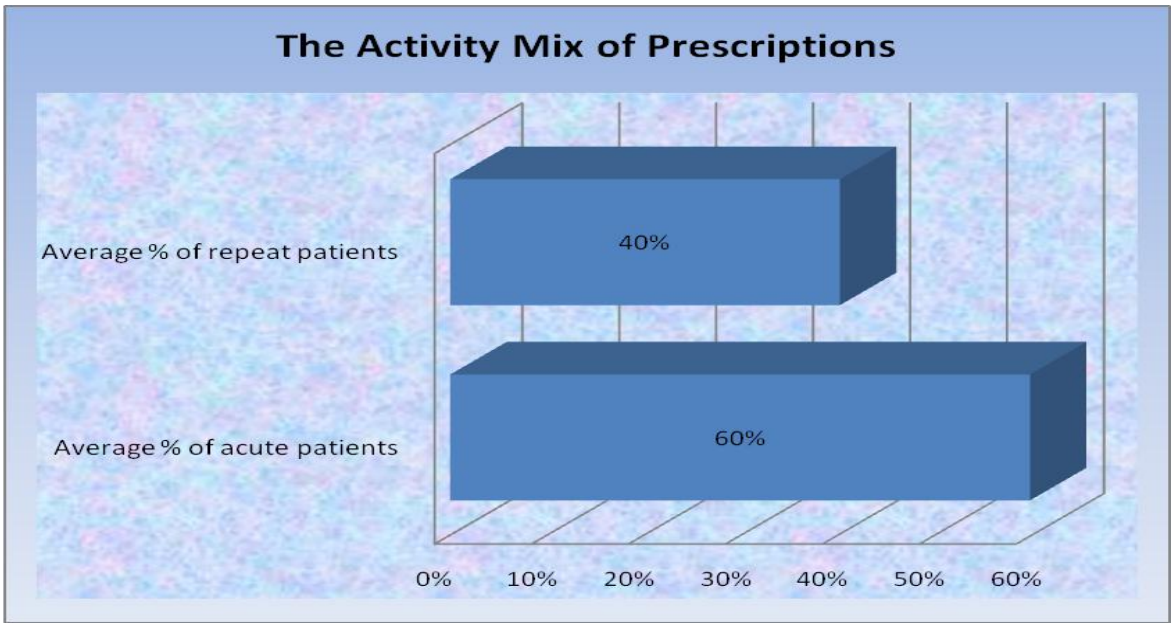


Figure 14: The activity mix of prescriptions

The activity mix of prescriptions to include the priority prescription is graphically represented in Figure 15 and summarised as follows:

- 1179 (55%) of prescriptions were acute prescriptions.
- 110 (5%) of prescriptions were for the priority acute patients.

- 845 (39%) of prescriptions were for repeat prescriptions.
- 15 (1%) of prescriptions were for priority repeat prescriptions.

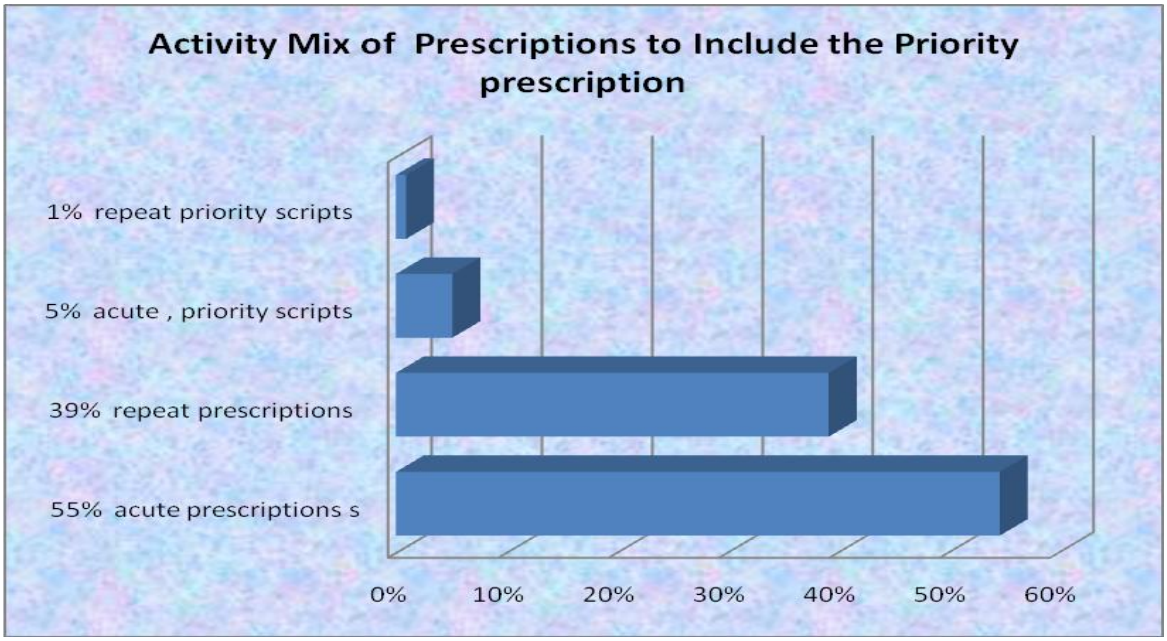


Figure 15: The activity mix including the priority prescription

Although the service time to dispense an acute, repeat or priority prescription is assumed to be the same, the difference lies in the time the priority prescriptions wait for service owing to the disregards for the first-in-first-out principle of service at the SBAH outpatient pharmacy. The implementation of a strategy to provide certain individuals with a priority status must be closely monitored because if left unchecked it can negatively affect the waiting times of all other prescriptions arriving subsequently. In an attempt to identify trends with regard to the arrival of priority prescriptions, the 30 minute arrivals of priority patients was determined and is graphically represented in Figure 16. Of the average of 431 arrivals of prescriptions per day, 6% of prescriptions received priority service. From Figure 16, it can be seen that the peak arrivals for priority patients occur between 10h00 and 13H30 however no clear trends are visible. The peak arrival of priority prescriptions however, does coincide with the peak arrivals of acute prescriptions.

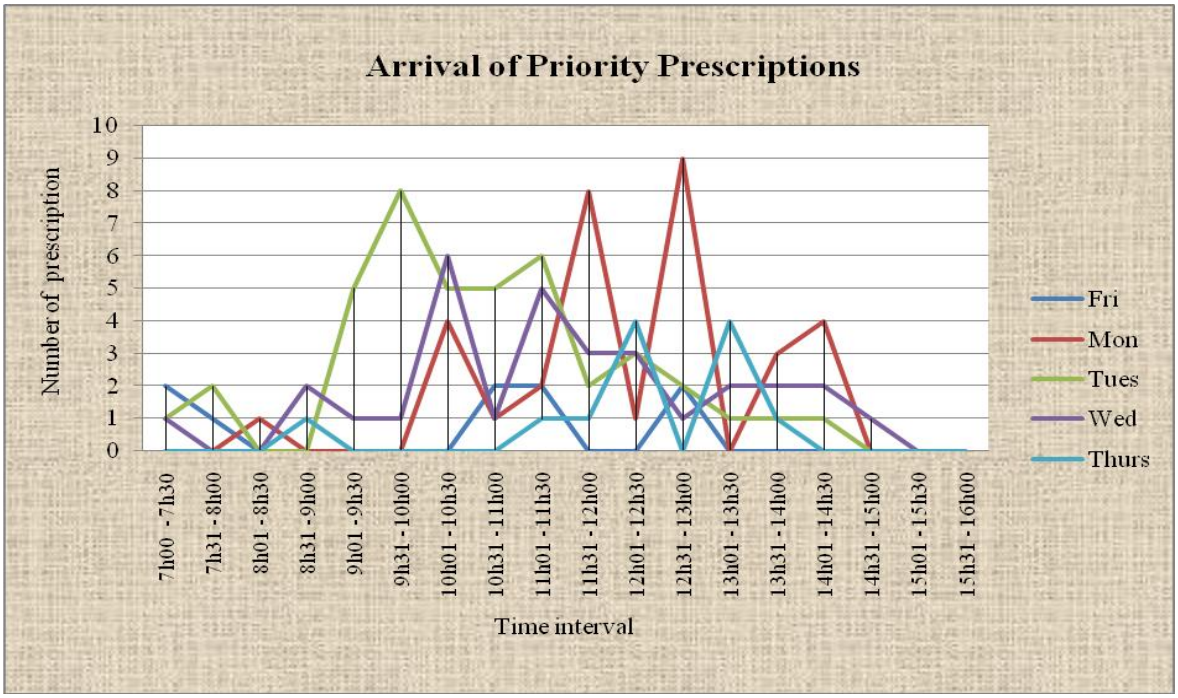


Figure 16: The arrival of priority patients

Nine priority categories were identified at the SBAH outpatient pharmacy as shown in Table 11. The highest number of 37 prescriptions received priority status on Tuesday, with only 9 prescriptions receiving priority status on Friday. Fifty six (48%) of all the priority prescriptions were for the priority category: Schedule 6. The priority categories: Schedule 6, radiotherapy and wheelchair prescriptions accounted for 86% of all priority service given. The wheelchair patients constitute approximately 18% of all priority service given. Observation highlighted that previously given priority status remained enforced, for example, a patient who arrived on foot to the outpatient pharmacy was prioritised just because there was a previously attached Wheelchair sticker: attached to the patients file. The probable misuse or abuse of the priority service offered at the outpatient pharmacy was not investigated during the research. Procedure to identify and grant priority status to patients should be carefully managed to ensure the prioritization of only genuinely deserving cases. All sick patients deserve special service and the abuse of the system by a few patients at the expense of other patients should not be allowed. Priority service was also given to family members collecting repeat medication on behalf of patients classified

as priority patients. The question remains as to whether this practice should be continued or not.

Compared with the sample waiting time of 01:07:15:

- The waiting time for all 13 priority patients as per Table 12 was 00:47:04 and this shows a significant decrease in waiting time to the magnitude of 00:20:11.
- The waiting time for the disable and two radiotherapy patients was 00:27:31, a decrease in the average waiting time of 00:39:44.
- The waiting time for the ten "Schedule 6" categories of priority patients was 01:01:24, a decrease in the waiting time of only 00:05:51.

The difference of 00:33:53 between the waiting time for the Schedule 6 priority category and that of the disable and radiotherapy priority categories was attributed to the additional step in the dispensing process for preparing and dispensing a Schedule 6 item. The waiting time for the disable and radiotherapy category of patients can therefore be assumed to be applicable to all categories of priority patients which do not require an additional preparation phase during the dispensing process. The significant decrease in the average waiting time by 00:39:44, explains why patients insist on retaining their priority status and why patient's family members also insist on receiving priority service. Eight of the 21 detailed investigations during the research received priority service, but were subsequently set aside as the patients did not arrive when called by the server. This may indicate that not all patients previously given priority status may have actually expected this service again. The process of forwarding the priority prescription to be beginning of all three of the secondary queues is the main reason for the much shorter average waiting time of priority patients and this is visible in the waiting times 1,2 and 3 as can be seen in Table 12.

The limitation of the study was that not all priority patients were included in the detailed investigations. The research methodology was able to indirectly compute the additional time required to prepare a Schedule 6 medication item during the dispensing process, and it also provided evidence that the waiting time of all other priority groups of prescription,

excluding the Schedule 6 priority category was significantly shorter, by almost half that of the sample waiting time.

6.4 Objective 4: To determine the average number of line items prescribed per prescription at the SBAH

The number of line items prescribed per prescription is an indirect indicator for the rational use of drugs at a hospital or clinic (MSH 1997). MSH (1997) clearly states that the longer and more complex the prescription, the more compliance is a concern, especially if the use of the medication significantly impacts the normal lifestyle of the patients (MSH 1997). The risk of side effects and drug**:**drug interactions also increases with a larger number of medications taken together (Science Daily 2007). Cheraghal *et al.* (2003) shows that training of all health care workers and regular monitoring of indicators are critical success factors to ensure improved patient compliance and clinical outcome.

GDH has a policy (GDH 1997) for the primary level of health care which recommends the prescribing of a maximum of four items per medical condition from which the patient suffers. There is however no such policy for the higher level of health care within the Province. Table 13 shows that the average number of items prescribed at the SBAH was 5 line items per prescription.

To clearly understand the prescribing habits of doctors at the SBAH, a detailed prescription analysis was performed using 413 detailed investigations from the sample population to quantify the number of prescriptions with the different number of line items prescribed. Table 14 on average 66% of the sample population had 5 or less items prescribed. Seventy one percent of prescriptions had 6 items or less prescribed and 77% of prescriptions had 7 or less items prescribed. Table 14 shows that the lowest number of items prescribed per prescription was 1 and the highest number of items prescribed per prescription was 24. The average number of 5 items prescribed per prescription may in actual fact be overstated due to the wide range of items prescribed per prescription.

In Gauteng, an undocumented output norm commonly used in capacity planning states that it should take on average one minute to dispense an item per prescription. To confirm this output measure, the time required to prepare an item per prescription for this research was computed and found to be 00:01:42, forty two seconds more than the unconfirmed output measure of 1 minute per item. An alternative method to confirm that the time taken to prepare a single item per prescription at the SBAH outpatient pharmacy is greater than one minute, involved dividing the total average service time of 00:07:54 by five, the average number of line items prescribed per prescription. The resultant time to prepare a single item is computed as 00:01:35 minutes, not significantly different from 00:01:42. Table 15 shows that only for prescriptions with 6 or more items prescribed, does the output measure of one minute per item become applicable. Since 60% of prescriptions seen at the SBAH have 5 or less items prescribed per prescription, the more appropriate output norm to be used at the SBAH is 00:01:42 per item, or 38 items per hour. However, a combination of the two norms can also be used for a more accurate capacity plan.

The Rules relating to the service for which a pharmacist may levy a fee (RSA 2009), a draft document for comments, recommends that the time to evaluate, prepare and dispense an item per prescription should be 00:05:30, approximately 3 times that which it takes to prepare an item at the SBAH outpatient pharmacy. The 00:05:30 is applicable to all sectors of pharmaceutical services within South Africa, including the community pharmacy sector. It can therefore be assumed that this "norm" implies only make-to-order prescriptions and has not factored in the make-to-stock commonly used within the public sector. The 00:01:42 as computed at the SBAH outpatient pharmacy may need to be confirmed by research performed at other hospitals within the GDH.

Due to a lack of norm from literature for the number of items to be prescribed per prescription at an academic hospital, it is difficult to determine the appropriateness of the findings of this research. Five items per prescription should be considered the new norm for the SBAH outpatient pharmacy and all future interventions should be either to decrease or maintain this level.

6.5 Objective 5: To theoretically determine the number of prescriptions that could be down referred to the primary level of care for clinical management.

A total of 429 detailed investigations were used to determine the appropriate utilization of tertiary services by patients. A total of 73 (17%) prescriptions were found to be down referable to lower levels of care while 356 (83%) prescriptions had drugs prescribed which were considered specialist drugs for use at only the tertiary level. It was therefore, concluded that on average 83% of the patients seen at the SBAH outpatient pharmacy appropriately utilize the tertiary level of health care. The evaluation of the patient's medical conditions was not included in the scope of the project therefore; the 17% of prescriptions considered down referable in the research may in fact be patients requiring tertiary care.

The unconfirmed concerns of pharmacy managers regarding the inappropriate utilization of level of care, as being one of the many reasons cited for long waiting times, was disproved with regards to the SBAH outpatient pharmacy. With the lack of national policy on imposing of penalties on the inappropriate use of services, it will remain the responsibility of provincial departments of health or individual tertiary institutions to devise procedures for the up and down referral of patients to ensure that all patients have equal access to specialist services in the case of SBAH. For the purpose of this research two distinct extremes have been discussed, that is, the tertiary or primary level of services. However, various cost-effective combinations of services along the continuum are possible and these need to be investigated to identify what is most appropriate for both the tertiary institution and for each individual patient's needs. The down referral of patients will require commitment, support and improved capacity to the primary level of health care services.

From the literature review some of the benefits of an effective and efficient down referral system can be summarised as follows:

- Manageable workload at the tertiary level of care.
- Budget available effectively used for tertiary care.
- More acceptable waiting times for all patients.
- Quality of service versus the quantity of service.

All of the above can only be realised if a disciplined approach is maintained at the SBAH to ensure that the "freed capacity" is not filled with other inappropriate level of care patients, but strategically used to improve the tertiary level of service and to improve the primary health level of service through the support of outreach programmes and training.

6.6 Objective 6: To determine the average number of medications requiring packing and the additional time required to pack an item during the dispensing process at the SBAH outpatient pharmacy

Packing of medication during the dispensing process introduces variations into the activity mix of prescriptions, requiring additional service time to prepare the prescription and thereby negatively affecting waiting times of patients at the SBAH outpatient pharmacy.

On average 2155 items are dispensed per day, which was calculated by multiplying the average arrivals per day by the average number of line items per prescription computed for the SBAH outpatient pharmacy. Of the 2155 items dispensed per day only 35 (1.6%) items required packing during the dispensing process. Of the average of 431 prescriptions received per day, 35 prescriptions equated to 8% of all prescriptions that required packing during the dispensing process.

Rational dispensing requires that all medication dispensed should be in sufficient quantities as prescribed for the patients' needs. The reasons why packing may be required during the dispensing process includes: different dosage instructions to suit the patient's age and weight, changes in the duration of treatment, lower or higher doses due to risk of drug interaction, amongst other. Packing during the dispensing process does not always signify that a make-to-order item is out of stock but only that the item requires special packing to meet the patient's needs. Pre-packing or the make-to-stock approach used in the public sector is intended to assist the dispensing process to alleviate the high workload seen in the public sector. A make-to-stock approach is not commonly used in the retail and private health care sector therefore, a norm indicating the number of items to be packed during the

dispensing process was not found in literature. Totally eliminating the packing of medication during the dispensing process is not a realistic expectation for the pharmacy profession however; the packing of medication during the dispensing process at the SBAH outpatient pharmacy should be maintained at 35 per day to maintain the average population waiting time of approximately 01:04:47.

The total additional time required to prepare and pack an item during the dispensing process has been calculated as 00:02:03. This is 00:02:03 over and above the average time needed to prepare an item on a prescription; therefore, the total time to prepare an item that requires packing during the dispensing process is 00:03:45. Although only 1.6% of the daily workload requires packing during the dispensing process the task will require 01:11:45 of the total 60 man-hours available per day at the outpatient pharmacy.

During the observation of the workflow and processes involved in the dispensing process, it was noted that there was minimal supervision by the pharmacist over the packing process. Procedures must be introduced to ensure improved compliance with this legislative requirement. The additional time required to pack an item during the dispensing process is a new input measure determined by this research and which could routinely be used for capacity planning at the SBAH.

6.7 Objective 7: To determine the number of prescriptions with an item out of stock and the additional time required to manage an out of stock situation at the SBAH outpatient pharmacy

An item out of stock during the dispensing process is another variable affecting the activity mix of the patients seen at the SBAH outpatient pharmacy. Normal procedure for all items out of stock at the SBAH outpatient pharmacy required that the doctor be consulted for an alternative medication to be prescribed. At the SBAH all outpatient clinic areas were notified of the item out of stock therefore, most acute prescriptions arrived at the outpatient pharmacy with an alternative drug already prescribed. The arrangement with the doctors was that despite being informed of an item out of stock, if the drug was still prescribed the

pharmacy would issue an "I Owe You (IOU) note", with which the patient could telephonically query, the availability of the drug. Monitoring the actual item out of stock and the reasons for items being out of stock was not part of the research methodology therefore, it could not be determined if the items out of stock were vital, essential or a non-essential (MSH 1997). Table 18 shows that the total number of items out of stock for the research period was 40 items on 39 prescriptions. The 40 items out of stock represents 1.9% of the average number of items dispensed per day. The 39 prescriptions with an item out of stock equates to 9% for the total research period, averaging to an approximate 2% per day. All prescriptions with the exception of one had one item out of stock and one prescription had two items out of stock.

Table 19 shows that the additional time required to manage an item out of stock was 00:00:04, four seconds more than that required for preparing an item on a prescription. The time that would normally be spent on preparing an item per prescription was now spent on issuing an IOU note, explaining to the patient the reason for the item out of stock and the procedure to obtain the stock in the future. Factors not factored into the time taken to manage an item out of stock include the following:

- Additional time required to answer telephonic query on the availability of drugs
- Additional time taken to dispense the medication once available
- The cost of the negative clinical outcomes due to an item out of stock
- Cost of the loss of confidence in the system

Ongoing operational research in the area of the actual items out of stock needs to complement this research, in order to ensure a continuous supply of essential drug at all times.

6.8 Objective 8: To determine the service rate, the service distribution and the average number of servers serving the patients at the outpatient pharmacy

The capacity planning process used at the SBAH outpatient pharmacy comprises a level capacity plan. Table 23 shows that 39% of the total staff establishment and 40% of the

total pharmacists staff establishment were routinely allocated to the outpatient pharmacy. The outpatient pharmacy had its own pharmacy managers and functioned as an "independent" unit with regard to leave and allocation of staff to the various service points within the outpatient pharmacy. Only in dire situations will additional staff be deployed to the outpatient pharmacy.

The arrival and service rates representing inputs and outputs of a system are commonly utilised in queuing theory. The average service rate for the SBAH outpatient pharmacy was calculated as 2154 prescriptions for the total research period, averaging to 431 prescriptions serviced per day and 24 prescriptions per 30 minute time interval. The total service rate at the SBAH outpatient pharmacy was 99.5%. The graphical representation of the arrival versus the service rate is shown in Figure 17.

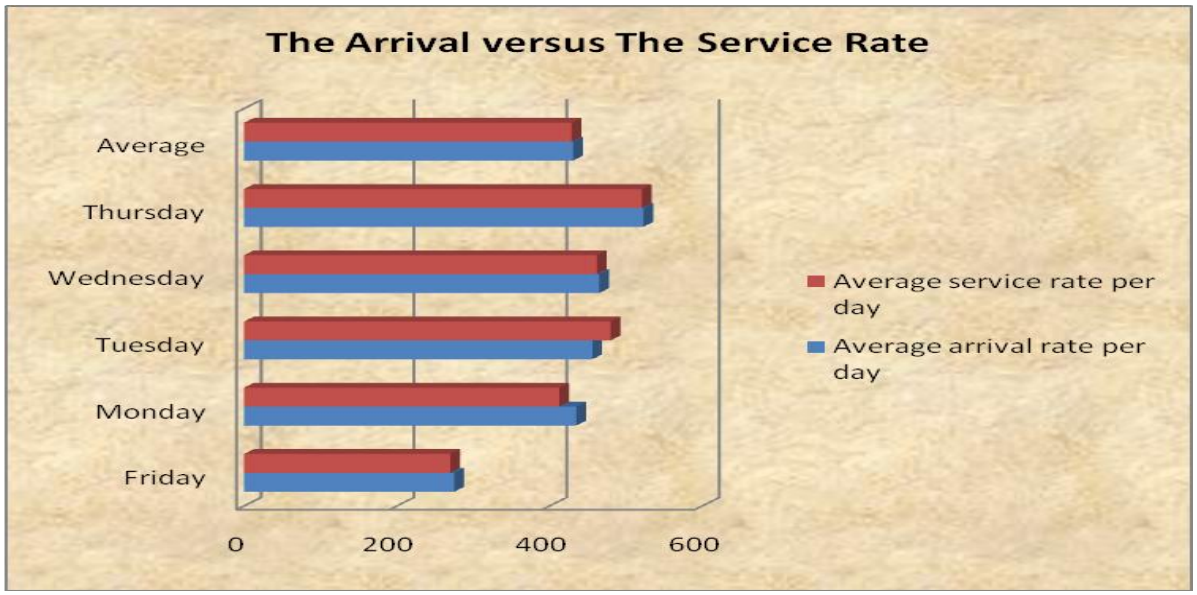


Figure 17: The arrival versus the service rate

Figure 17 shows that for all days of the research all the prescriptions arrived were serviced on the same day. All health care settings attempt to serve all arrivals because patients cannot be turned away without their medication. The arrival and service rates together with the number of servers are inputs into the queuing theory's utilization rate and this was computed as 0.995 for the SBAH. In queuing theory it is only the number of servers, who

directly dealing with the patient, face to face (Hillier and Hillier 2003) that inputs into the utilisation rate. All other staff members working behind the scenes picking and checking and are not regarded as servers in the multiphase system (Stevenson 1989). An interesting observation was that the utilisation rate was one for all days of the research since the service rate closely matched the arrival rate. SBAH outpatient pharmacy did not fulfil the requirement of the utilisation rate being less than one and therefore queuing theory could not be further applied to the queue system at the SBAH outpatient pharmacy.

An alternate method proposed to assist with the provision of information on the expected length of the queues comprised the infinite source values tables for the length of the queue (Stevenson 1989). For a utilization factor of one with one server, an "infinite" queue length was predicted for the SBAH outpatient pharmacy. As Shown in Table 24, a total of 23 prescriptions waited for service to begin, while 18 prescriptions were partially serviced waiting for the next phase of service to begin. The 41 prescriptions waiting in the system to be served were considered substantial or "infinite" (infinite not quantified in queuing theory) during the research. Still using the infinite source values tables, but increasing the number of servers to 2, the length of the queue predicted decreases to 0.333 patients with a 33.3% probability of zero patients in the system. Stevenson (1989), states that for a heavily loaded system a modest change in the number of servers can lead to a sizable improvement in the average number of persons waiting in the queue and the average waiting times. SBAH outpatient pharmacy should as part of its improvement strategy, test the above by increasing the number of servers to 2 and note the impact on waiting times.

Unable to utilise the queuing theory as a capacity planning tool and the limited use of the infinite source values tables, required yet another method to determine the adequate capacity required to meet the demand made for pharmaceutical services at the SBAH outpatient pharmacy. Attention was directed towards determining the capacities of operations within an organisation. The capacity of any operation can be determined in terms of either design, effective or actual capacity (Pycraft *et al.* 2004). Design capacity is the theoretical capacity available to the system before the avoidable or unavoidable losses are factored in (Pycraft *et al.* 2004). The effective capacity is the design capacity less the

unavoidable losses of the operational system (Pycraft *et al*. 2004). The actual capacity is the effective capacity less the avoidable losses of the operational system (Pycraft *et al*. 2004).

From Table 23, the following can be observed:

- Sixteen staff members were allocated to the outpatient pharmacy and this could be correlated to the design capacity of the system.
- The 12 of the 16 staff members physically present at the SBAH outpatient pharmacy could be correlated to the effective capacity. The difference of four staff members between the design and the effective capacity could be equated to the unavoidable losses that occurred due to personnel being on leave.
- The 30 minute time interval observation shows that on average only 8 of the 12 staff were continuously involved in the dispensing process. The difference of the four personnel could be equated to avoidable losses which could be due to extended tea and lunch, looking for prescriptions, patients' queries, or simply due to variation that occur when dealing with complex human behaviour which cannot be accurately predicted.

The two capacity measures commonly used in operations include utilisation and efficiency. At the SBAH outpatient pharmacy the utilization of the capacity was 50%, calculated as the actual capacity divided by the design capacity, and the efficiency of the capacity was 67%, which is the actual capacity divided by the effective capacity. The above is a brief introduction to an alternate method to determine efficiency and utilization at the outpatient pharmacy and could be used together with other methods for capacity planning. To effectively use the capacity measures of operations, a detailed investigation into the avoidable and unavoidable losses is a pre-requisite.

Yet another, commonly used method to determine capacity utilization was the calculation of the available man-hours divided by the time taken to perform a specific task.

Table 24 showed that on average 8 staff members were continuously involved with the dispensing process, where 3 personnel picked the prescriptions, 4 checked and labelled the medications and 1 dispensed the prescriptions on a daily basis. The average capacity available for each dispensing process was calculated as: the total number of staff members performing each of the dispensing functions multiplied by the total number of working hours per day, calculated as 7.5 hours per day and divided by the service time for each of the respective dispensing functions from Table 5. The average capacity per day in prescriptions was:

- Four hundred and eighty five prescriptions for the picking process.
- Five hundred and five prescriptions for the checking and labelling process.
- Two hundred and ninety prescriptions for the dispensing process.

The capacity varied across the various dispensing process with the greatest capacity being at the checking and labelling process. This additional capacity was strategically placed because the staff responsible for checking and labelling could assist with both the picking as well as the final dispensing process as required. On average 431 prescriptions were seen per day, resulting in 80% of the picking capacity being utilised, and 85% and 148% of the checking and labelling and dispensing capacity being utilised respectively. The average utilisation of the available capacity for the dispensing process per day was 104%. It can therefore, be concluded that 8 staff members working at the out patient pharmacy are inadequate to managing the daily average workload seen at the SBAH outpatient pharmacy. The basic level pharmacist assistant responsible for picking the prescription could not be utilised with the checking and dispensing functions therefore, the daily utilisation rate may in actual fact be higher than 104%.

A closer look at Thursday shows that the workload was 1.2 times that of the average daily workload. On Thursday the average capacity would be totally inadequate to meet the demand made for pharmaceutical services but due to good capacity planning demonstrated at the SBAH outpatient pharmacy the number of personnel continuously involved in the dispensing process was increased to where 4 personnel picked, 5 personnel checked and

labelled and 2 personnel dispensed the prescription. The capacity had been increased to 1.35 times that of the average. The average capacity per day in prescriptions was:

- Six hundred and forty six prescriptions for the picking process.
- Six hundred and thirty for the checking and labelling process.
- Five hundred and eighty prescriptions for the dispensing process.

The utilization of the available capacity on Thursday was 81% for picking, 83% for checking and labelling and 90% for dispensing. The average daily utilisation was an approximate 85%, an indication of sufficient overall capacity on Thursdays. Despite adequate capacity to manage the workload on Thursday a disproportionate increase in the waiting times was noted. The linear extrapolation performed in section 6.2 also confirms that the increase in waiting times expected for Thursday should only have occurred if the average staff complement remained the same. The staff complement did not remain the same but increased appropriately to meet the workload of the busiest day of the week. The probable causes for the disproportionate increase in waiting time may be as follows:

- The arrival of patients in relation to each other was much quicker on Thursday as can be collaborated by the higher number of patients seen for many of the 30minute time intervals.
- The impact of the 70 prescriptions arriving during the first 30 minute time interval on Thursday morning cascaded throughout the day making "catch up' almost impossible even with adequate capacity.
- The increase in capacity on Thursday by 1.35 times the average was still insufficient to manage the huge workload in the morning.
- Chase demand on Thursday was with the inappropriate cadre of staff, who could legally not perform all the functions of the dispensing process.
- Qualitative factors influencing optimal utilization of available capacity such as fatigue, burnout and time waster, could all be probable causes that would require further investigation.

The recommendation is to investigate the period by period capacity requirement for all days of the research and to ensure the adequate provision of capacity to maintain the

average population waiting times throughout. A possible solution may be found by investigating the avoidable loss of capacity at the SBAH outpatient pharmacy.

The service time distribution, an aspect of service delivery, is shown by the negative exponential curve in Figure 18. Most prescriptions will be serviced within a short period of time and some prescriptions will require much longer service times.



Figure 18: The service distribution

The most frequently occurring service time as seen in Figure 18 is 00:04:33 while the service time calculated during the computation of the secondary waiting and service times show the average service time to be 00:07:54. Due to the high degree of variation in the service times with the shortest service time being 00:01:33 and the longest service time being 00:19:33, the average service time calculated may be overstated than it actually is. The service for prescriptions was not separately investigated for each specific day of the research period; however; a closer look at the service times for Thursday may provide an additional explanation for the increase in the waiting times beyond that of the 90 minute benchmark.

6.9 Objective 9: To determine the average number of errors made during the dispensing process and the additional time required to rectify an error at the SBAH outpatient pharmacy

Errors should never occur as they can be fatal, lead to less than optimal health outcomes and can affect the confidence in the health system. Thirteen percent, which represents 62 prescriptions of 467 prescriptions evaluated had an error. The total number of errors for the research period was 66 errors on 62 prescriptions. Sixty six errors of the average of 2155 items dispensed per day equates to a 3% error rate. The 62 prescriptions with errors equated to a 14% error rate for the total research period, averaging to an approximate 3% per day. The types of errors found during the research are tabulated in Table 29. Fifty two percent of errors, where for the incorrect quantity of medication picked followed by 30% of errors due to the item not picked or omitted during the picking process, and 18% of errors were due to the incorrect item being picked.

Consistent identification of errors is critical for pharmaceutical care. The dispensing process at the SBAH outpatient pharmacy is ideally designed to identify errors made by basic level pharmacist assistants during the picking process. A double check process was in place and occurred during the checking and labelling and the final dispensing process. At the SBAH outpatient pharmacy it is mandatory for the basic level pharmacist assistant to sign the prescription picked, allowing for the easy identification of the person responsible for the error. When errors were identified, in-service training was immediately provided by the pharmacist who assists the basic level pharmacist assistant to rectify the error. The in-service training is important for the rendering of consistent and reliable service (CSZ 2004-7).

The following labelling errors were not monitored at the SBAH outpatient pharmacy as the pharmacist assistants are not involved in the labelling process:

- Items not labelled.
- Incorrect directions.
- No directions.
- Patient details incomplete or lacking on the label.

Section 6.8 shows some idle time during the picking process, where only 80% of the total picking capacity was used. The approximate 20% of the idle time cannot be used for other dispensing functions but could in future be used, by including the labelling of medication into the picking process. The label can still be checked and corrected by the staff checking the prescriptions. Competency had been displayed during the picking process as 97% of items were correctly picked. This displayed competency by the basic level pharmacist assistant can be extended to the labelling of the medication with in-service training and support from the pharmacist.

The concern of pharmacists regarding the high error rate made amongst pharmacist assistants has been disproved at the SBAH outpatient pharmacy. The error rate was not considered to high and the design of the dispensing process allows for the easy identification and rectification of the errors made. Pharmacist assistants must be utilised within their scope of practice, releasing pharmacists to perform value adding activities in the field of pharmaceutical care (Al-Shaqha and Zairi 2000). With the high turnover of pharmacists within the public sector the pharmacist assistants will be the future providers of routine pharmaceutical services and all training must support this future eventuality.

It is generally assumed that the greater the number of items per prescription, the greater the error rate. The findings of the research, disproves this assumption as seen in Figure 19.
The greatest number of errors occurred on prescriptions with 7 line items prescribed and no errors occurred on prescriptions with 15 or 16 items prescribed. Sixty one percent of errors occurred on prescriptions with 7 or less items prescribed and 83% of all errors occurred on prescriptions with 11 items or less.

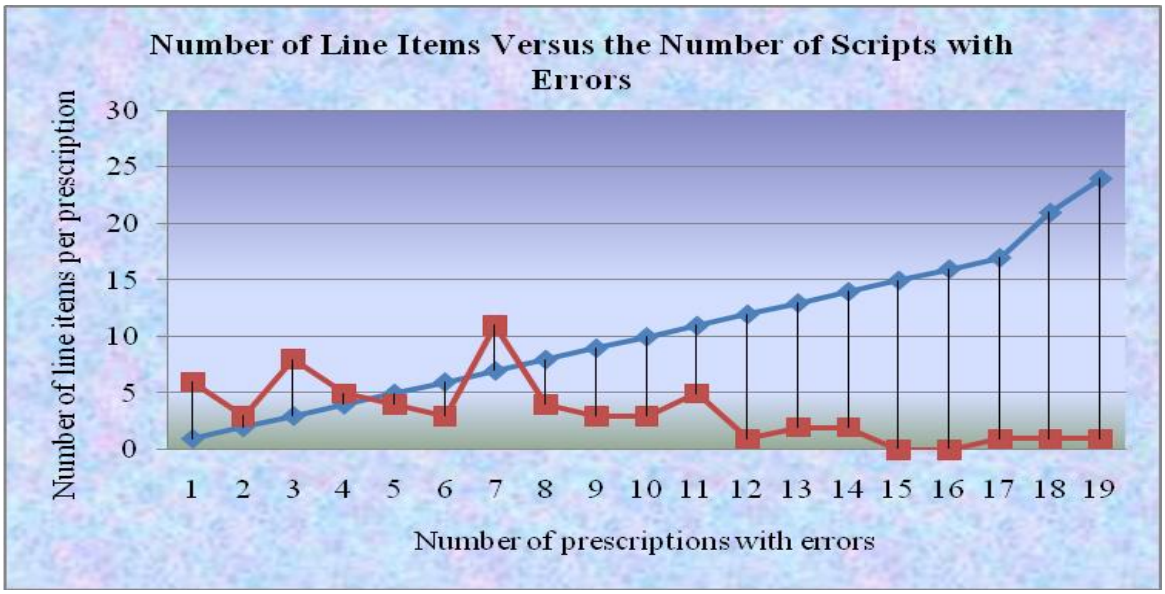


Figure 19: The Number of line items prescribed versus the number of errors made

The provision of in-service training, while rectifying errors, also adds to the service time of the prescription. The average additional time taken to rectify a prescription with an error was calculated as 00:03:09 as seen in Table 32, and this is above the average waiting time to dispense an item per prescription therefore, the total time to rectify an error on a prescription was 00:04:51. For an average of 13 errors per day the average additional time required per day to rectify errors is 00:40:57 of the total of 60 man-hours available per day. Together the time required to rectify errors and to pack an item during the dispensing process was approximately two hours.

Skips and slips are generally an inherent aspect of the dispensing process exacerbated by packing of medication during the picking process, errors and out of stock items on the prescription. The slips and skips in the system must be actively managed and minimised at the outpatient pharmacy to ensure patient satisfaction with fairness of the waiting times and service provided.

6.10 Findings supporting objective 10: To observe the workflow, layout, attitude of staff and other interruptions affecting the supply of pharmaceutical services at the SBAH outpatient pharmacy

The qualitative analysis showed that the following processes deemed necessary for service delivery were never considered as "demand" factors affecting pharmaceutical services and include the following:

- Pre-emptive priority service given to prescriptions set aside. This category of prescriptions received pre-emptive service, a priority status "higher" than that compared to the other priority prescriptions that received non pre-emptive priority service.
- The additional time required to find patient files after the prescription has been dispensed and retained at the pharmacy can be classified as another demand factor affecting pharmaceutical services. The patient's prescriptions are retained at the pharmacy as a service to the registry department, in order to ensure that patients' medical records are retained at the hospital. Some patients present themselves with "legitimate" reasons for requesting their files again and staff members involved in the picking process were deployed to perform this function in a pre-emptive fashion, delaying the service of other prescriptions in the queue.
- The management of the bulky patients' files to ensure the integrity of the file.
- The time required to find the prescription in the patient's medical files.
- Utilising the pharmacist to perform functions that can be performed by pharmacist assistants can be described as additional demand made on the pharmacists' time. The inappropriate utilisation of pharmacists to perform the labelling function is an internal process affecting the demand for pharmaceutical services at the SBAH outpatient pharmacy. The appropriate utilization of the pharmacy personnel is essential for the quality and cost-effective delivery of pharmaceutical services.
- Addressing some if not all of the slips and skips affecting the dispensing process may eliminate the need to address the many queries from patients.

This newly identified "demand factor" may require future investigation and quantification to determine its impact on the average population waiting times. Improvement plans to

address this newly identified demand factor may not significantly impact waiting times but will significantly impact efficiencies in the outpatient pharmacy.

CHAPTER 7: CONCLUSION AND RECOMMENDATIONS

The methodology used successfully elicited the information required to assist with the quantification of the factors affecting the supply and demand for pharmaceutical services as required by the objectives. Many of the undocumented, unconfirmed factors cited for long waiting times within the public health care sector were either validated or disproved.

The waiting time from the research validated the GHD waiting times collected by the Quality Assurance Department. The waiting time information supplied by the Quality Assurance Department of GDH can in future be employed in improvement strategies with confidence. The average population and sample waiting time for the research were within the average waiting time benchmark of 90 minutes set for the SBAH outpatient pharmacy. However, all improvement strategies must acknowledge that 36% of patients waited longer than the average population waiting time and 21% of patients waited longer than the 90 minutes average waiting time benchmark set for the outpatient pharmacy. Attention must also be given to the fact that 89% of the time, prescriptions waited for some service to begin, while only 11% of the total waiting time constituted service time. Only 2% of the average sample waiting time was face-to-face interaction between the server and the patient.

For prescriptions set aside, discipline is required to minimise the pre-emptive service given to the dispensing of these prescription. If more patients take advantage of the service of prescriptions being set aside, and return at their convenience to collect their medication, on demand, will negatively influence the waiting time of all other patients, as the first-in-first-out principle will be frequently disregarded. Priority services were provided to nine categories of patients seen at the SBAH outpatient pharmacy. The granting of priority status to the current 6% of priority patient's, needs to be reviewed to ensure that the time benefit of 00:30:53 is not abused at the expense of other sick patients waiting in the queue.

The activity mix of prescriptions seen at the outpatient pharmacy comprised 60% acute prescriptions and 40% repeat prescriptions. Seventeen percent of the sample population

were theoretically classified as being down referrable, while 83% of the sample population were considered to be appropriately utilising tertiary services. The arrival of prescriptions at the pharmacy remained random with 92% of prescriptions arriving within 0-3 minutes of each other, which is faster than the total service time of 00:07:54 per prescription, indicating that queues will always be a feature at the SBAH outpatient pharmacy. Thursday, the busiest day saw almost twice the number of patients compared with the least busy day, Friday. The equalisation of the workload to idle times during the day or the week, will afford the opportunity to better manage the demand for pharmaceutical services and this may relieve the pressure to provide additional capacity to the SBAH outpatient pharmacy.

The average sample population waiting time was also a function of the following demand factors:

- Eight percent of prescriptions requiring packing during the dispensing process.
- Three percent of the prescriptions required rectifying of errors made during the picking process.
- Two percent of prescriptions required time to manage an item out of stock.

The following demand norms for the SBAH as determined during the research could be applied during capacity planning to better meet the demands for pharmaceutical services and include the following:

- The average additional time required to prepare an item per prescription was 00:01:42.
- The average additional time required to pack an item during the picking process was 00:02:03.
- The average additional time required to rectify an error made during the picking process was 00:03:09.
- The average additional time to manage an item that was out of stock was 00:00:04, excluding the time when the patient returned to collect the out of stock medication.
- The average number of items prescribed per prescription was 5 items.

Steve Biko Academic Hospital's pharmacy allocates an approximate 39% of its total staff establishment to the outpatient pharmacy to meet the demand for pharmaceutical services. The current level-capacity plan for the SBAH outpatient pharmacy is however, considered inadequate, since the average utilisation of the capacity continuously involved in the dispensing process is 104%. In determining the appropriate level of capacity required at the SBAH outpatient pharmacy, consideration must first be given to the avoidable and unavoidable capacity losses. The current efficiency of capacity and utilisation of capacity is an approximate 67% and 50% respectively, which indicates that there is potential for improvement.

The research confirmed, the following reasons cited for long waiting times at the SBAH outpatient pharmacy and include:

- The lack of an appointment system as a demand management strategy.
- Inadequate staffing to meet the demand, this however, still needs to be further investigated through the quantification of the avoidable and unavoidable capacity losses at the SBAH outpatient pharmacy.
- The late starting times of the specialist outpatient clinics.

The research disproved, the following reasons cited for the long waiting times at the SBAH outpatient pharmacy and include:

- The large number of errors made by pharmacist assistants during the dispensing process.
- The low morale of staff and the high absenteeism of staff.
- Large number of patients returning daily to collect medication previously out of stock.
- The erratic arrivals of patients to the outpatient pharmacy.
- Large number of items requiring packing during the dispensing process
- The inappropriate utilisation of tertiary level of service

Quantifying the above factors has provided a better perspective of how some of the above factors affected waiting times in pharmacies within the public health care sector.

The findings of this research will serve as historical standards or a baseline against which future performance can be measured. The case methodology developed can easily be applied over again within the same hospital to monitor the impact of change strategies, thereby allowing for direct comparison with the baseline information. The research findings will contribute positively towards the public sector repository for pharmaceutical services especially the information such as the time taken to prepare an item per prescription, the time to rectify an error and the time to pack an item during the dispensing process, which all can be considered new baseline norms, since they were not previously available.

The findings of this research from the pharmacy perspective will provide valuable insight to other health care professionals in understand the impact of their practices and procedures on the demand and supply of pharmaceutical services at the SBAH outpatient pharmacy. To re-iterate, the current disparity between the supply and demand for pharmaceutical services is often seen as a pharmacy operation failure; however, a closer examination of the systems dynamics model does reveal that the long pharmacy waiting times at the SBAH outpatient's pharmacy are influence by many other stakeholders and factors over which pharmacy has little control.

The additional advantage of the methodology employed is that it can be developed into a standard waiting time framework for monitoring demand and supply factors at all hospitals within GHD. The case methodology can be applied to other institutions to increase the reliability of the methodology and it provides external validation to the appropriateness of the interpretations and recommendations made. The findings of the research can be used for comparative purposes and for identifying and learning from best practices across all hospitals. Comparison does not necessarily imply that one hospital is better or worse than another, it only assists in identifying differences between processes used at the various hospitals. Stevenson (1989) stated that the competitive advantage for many organisations is contained within differentiated queue elements and characteristics. Therefore, it has becomes important to understand the dynamic of the different queue elements and

characteristics used, within the various public sector hospitals, in an attempt to influence patient waiting times and satisfaction.

It can be concluded that the following contributed to effective and efficient pharmaceutical services provision at the SBAH outpatient pharmacy:

- Reasonable capacity planning for the outpatient pharmacy.
- Motivated staff and the positive attitude of staff despite the high workload.
- Minimum time wasted, for example minimal telephone calls.
- In-service training for the learner basic and post basic pharmacist assistant and the pharmacist intern.
- A dispensing process that facilitates the following:
    - The segregation of duties and the assignment of responsibility for tasks to staff members.
    - The division of the dispensing process into manageable processes without any competing areas of responsibility.
    - Optimal utilization of all categories of staff.
    - Adequate supervision of tasks by the pharmacist

All systems have the capacity for improvement, including best practice sites. The following recommendations will assist in creating awareness of the possible areas for improvement in the workflow, layout and processes within the pharmacy and which may improve the either the actual and perceived waiting times of patients.

7.1 Recommendations

Facility improvements recommendations:

1. The rearrangement of the checking and labelling workstations within the outpatient pharmacy to create a new area for the systematic queuing of prescriptions awaiting dispensing.

2. The redesign of the queue marshals' workstation to include ergonomic standards for work-surfaces and appropriate seating arrangements to minimize stress and physical strain due to improperly designed working areas.
3. To reposition the chairs at the serving windows, to face the serving windows.
4. The serving windows are raised or appropriate seating be provided to improve the communication between the server and the patient.
5. The installation of partitions at all the serving windows, for the creation of semi-private counselling areas to ensure confidentiality during counselling.

Demand management recommendations:

1. The equalization of the workload during the week by the shifting of repeat patients to identified idle time during the days or weeks together with the introduction of an appointment system that is time specific.
2. The review of all prescriptions with greater than the average of five items per prescription to minimise the duplication of pharmacological items, drug interaction, possible side effects and the extent of intrusion of the medication on the patient's lifestyle.
3. Review the prescriptions classified as being down referable to determine whether these patients could in actual fact be down referred to lower levels of care for clinical management.
4. Address all unusual requests for the different pack sizes of medication to minimise packing during the dispensing process.
5. The unavailability of drugs was not considered a huge problem; however, this still requires regular monitoring. Patients returning to collect an item previously out of stock increases the monetary and time cost to the patient receiving service within the public health care sector. The psychological cost or concern regarding the unavailability of medication can negatively affect the patient's clinical outcome.
6. All valid prescriptions must be clearly marked for easy identification during the repeat dispensing process.

7. Discipline at the query window. All prescriptions set aside should be issued on the hour and not on demand. A systematic approach to dealing with prescriptions set aside will ensure that these prescriptions do not receive pre-emptive priority status.
8. A time limit is set after which a patient may query the progress of their prescription and not before. This is to ensure a reduction in the number of queries received at the pharmacy.
9. Patients requesting their files to be retrieved, after they have been retained at the pharmacy, should be redirected to the registry department who can then retrieve the patient's file.
10. Hospital management and a multidisciplinary team to determine guidelines for the extent of patient's medical history that should be contained in a patients file for effective and efficient clinical and pharmaceutical management of the patient. This will improve file management throughout the system.
11. Two months' repeat prescription to chronic stable patients is allowed within the GDH. A process could to be implemented at the SBAH outpatient pharmacy whereby the patients can request this service for all or part of the remaining repeats, thereby decreasing the number of patient visits to the hospital. This approach however, has the limitation of negatively influencing pharmaceutical care of the patient. Dispensing two months' medication at a time will require improved drug supply management at the SBAH outpatient pharmacy.
12. A separate queue for repeat patients may be considered, however this may aggravate the slips and skips in the system.
13. A review of the queue marshal's responsibility to include patients' queries.
14. To implement a procedure for the evaluation of the priority status given to patients. Clear guidelines are required as to who will receive long-term versus daily priority service. The policy should also address the issue of care givers or representatives of patients receiving priority status.

Supply management recommendations:

1. Increase the number of servers at the outpatient pharmacy.
2. Additional chase demand on Wednesday and Thursday morning to minimise the cascading effect of the high workload into the remainder of the day.
3. Relief for the queue marshal during tea and lunch times.
4. Implementation of a computerised dispensing system at the outpatient pharmacy which will allow for easier prescription retrieval and may obviate the need to manage patient files.
5. A system to be implemented to monitor staff responsible for variations within the system and for the implementation of individualised training or a development plan.
6. Improve adherence to legislative requirements, such as packing of medication under supervision at all times and to ensure confidentiality and privacy is provided during the final dispensing process.

The work processes were efficient during the research period. However, the pace of service at the SBAH outpatient pharmacy may not be sustainable for long periods of time and must be addressed during the improvement planning processes.

Recommendations to improve the perception of the service:

1. The finding of this result and the improvement strategies to be shared with the patients. A conspicuous display of the expected waiting times and the actual waiting times per month.
2. "Edutainment" to be provided to patients waiting for service. The television, place above the serving windows, be re-positioned to prevent strain on the patients' necks and the volume increased so that it is audible to the waiting patients. Health educators within the hospital should provide regular information and engage the patients on appropriate topics for discussion.

3. Post-computerization of the outpatient pharmacy, a statement may be issued with the value of the medication dispensed to the patients. This will create awareness of the value of the service being received.
4. To improve the service and personal value by increasing the service time with patients. The patients must be provided with more than just label reinforcement. Patients should be given the opportunity to ask any question in a private and confidential manner.
5. Slips and skips are inherent aspects of the dispensing process, however all attempts should be made to minimize slips and skips especially at the final dispensing process where prescriptions await dispensing.

The recommendations made have been categorised into facility, demand and supply improvements. The recommendations should not be implemented separately, but in a holistic manner to ensure that improvements in one area do not create bottlenecks in other areas, especially since the output of one process is the input into another process. The recommendations of the research should be incorporated into the comprehensive improvement plan at the hospital.

7.2 Suggestion for future research

As mentioned during the discussion the scope of the research was limited and many aspects were not included. The case methodology used is incremental and can be modify to include any aspect as deemed necessary. The case methodology allows for the use of the data collection form in its entirety or in part. Regular and ongoing operational research to complement the finding of this research could be done in the following areas to:

- Identify the actual items packed during the dispensing process.
- Identify the actual items out of stock.
- Identify items where errors are made since the errors could be due to complicated dosage instruction.

- Investigate all prescriptions that are considered down referable for clinical management to include the clinical aspects of the treatment given and the patient's needs to identify prescribing habits of doctors.
- Ensure regular monitoring of the prescriptions with large number of items prescribed.
- To actively participate in the monthly waiting time monitoring and patient satisfaction surveys performed by the GHD Quality assurance department.
- To supplement this quantitative analysis of factors affecting demand and supply of services with an in-depth qualitative research.

The case methodology used limits the extrapolation of the results to other similar hospitals within the GDH. The methodology can however, be used at other hospitals to determine their baseline queue properties, all adding valuable information to the public sector repository for pharmaceutical services.

CHAPTER 8: REFERENCES

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CHAPTER 9: ANNEXURE

9.1 Annexure 1

The General Data Collection Form

Date: _____

Document No: _____

Time patient arrives at the pharmacy: _____

Description of task	Tick
New prescription	
Acute prescription	
Priority prescription (please state priority type)	

9.2 Annexure 2:

Dispensing Process Data Collection Form

Hospital:_____Date:_____Document No: _____

Time prescription arrives at the pharmacy: _____

Person picking	**Tick**	**Description of task**	**Time**
Pharmacist		New prescription	
Learner basic PA		Acute prescription	
Qualified basic PA		Priority prescription (please state priority type)	
Learner post basic PA		Time prescription taken for picking	
Qualified Post basic PA		Number of items per prescription	
Pharmacist intern		Number of items requiring packing	
		Number of items out of stock	
		Time other intervention began	
		Time other intervention finished	
		Time prescription set aside for checking	
Person checking	**Tick**	**Description of task**	**Time**
Pharmacist		Time prescription taken for checking	
Qualified Post basic PA		Number of items per prescription	
Pharmacist intern		Time other interventions began	
		Time other intervention finished	
		Time prescription set aside for dispensing	
		Can the prescription be down referred (Y/N)	
		Incorrect quantity picked	
		Incorrect item picked	
		Item on prescription omitted	
Person dispensing	**Tick**	**Description of task**	**Time**
Pharmacist		Time prescription taken for dispensing	
Qualified post basic PA		Time prescription dispensed	
		Time prescription set aside	
		Time prescription set aside - collected	

9.3 Annexure 3

Checklist for observation

Date:_____

DESCRIPTION OF TASK TO BE COMPLETED DURING THE RESEARCHER OBSERVATION
To map the workflow and layout of the pharmacy and the patient waiting area.
To observe the arrangement of the pharmacy, the orderly and neatness of the pharmacy.
To obtain the staff structures of the academic hospital and the tea and lunch schedules.
Identify and document observable distractions from normal dispensing duties for example telephone calls, filling of shelves, visits from other health care practioners and so on.
Note the drug procurement process from the store and observe the process of filling of shelves with medication during the day.
Observe the attitude of staff towards patients and other staff members, for example friendly, courteous and so on.
Observe if patients were counselled.
Collect the normal workload statistic for the day, completed by dispensing staff. This is to reconcile the total number of prescriptions served and the total number of items dispensed.
Ensure that all staff has synchronised their watches to the one large dial digital clock provided, to minimise time variations during the data collection process.
Note the number of servers and support staff and the number of prescriptions waiting in the queue every 30 minutes
Other observations:

9.4 Annexure 4

30 minute Data Collection Form

Date: _____Document No:_____

Time of observation	Number of prescriptions waiting to be picked	Number of prescriptions being picked	Number of staff members picking	Number of prescriptions waiting to be checked	Number of prescriptions being checked	Number of staff members checking and labelling	Number of prescriptions waiting to be dispensed	Number of prescriptions being dispensed	Number of staff members dispensing	Number of prescriptions not collected at end of day
7H30										
8H00										
8h15										
8H30										
8h45										
9H00										
9H30										
10H00										
10H30										
11H00										
11H30										
12H00										
12H30										
13H00										
13H30										
14h00										
14H30										
15H00										
15H30										
16H00										

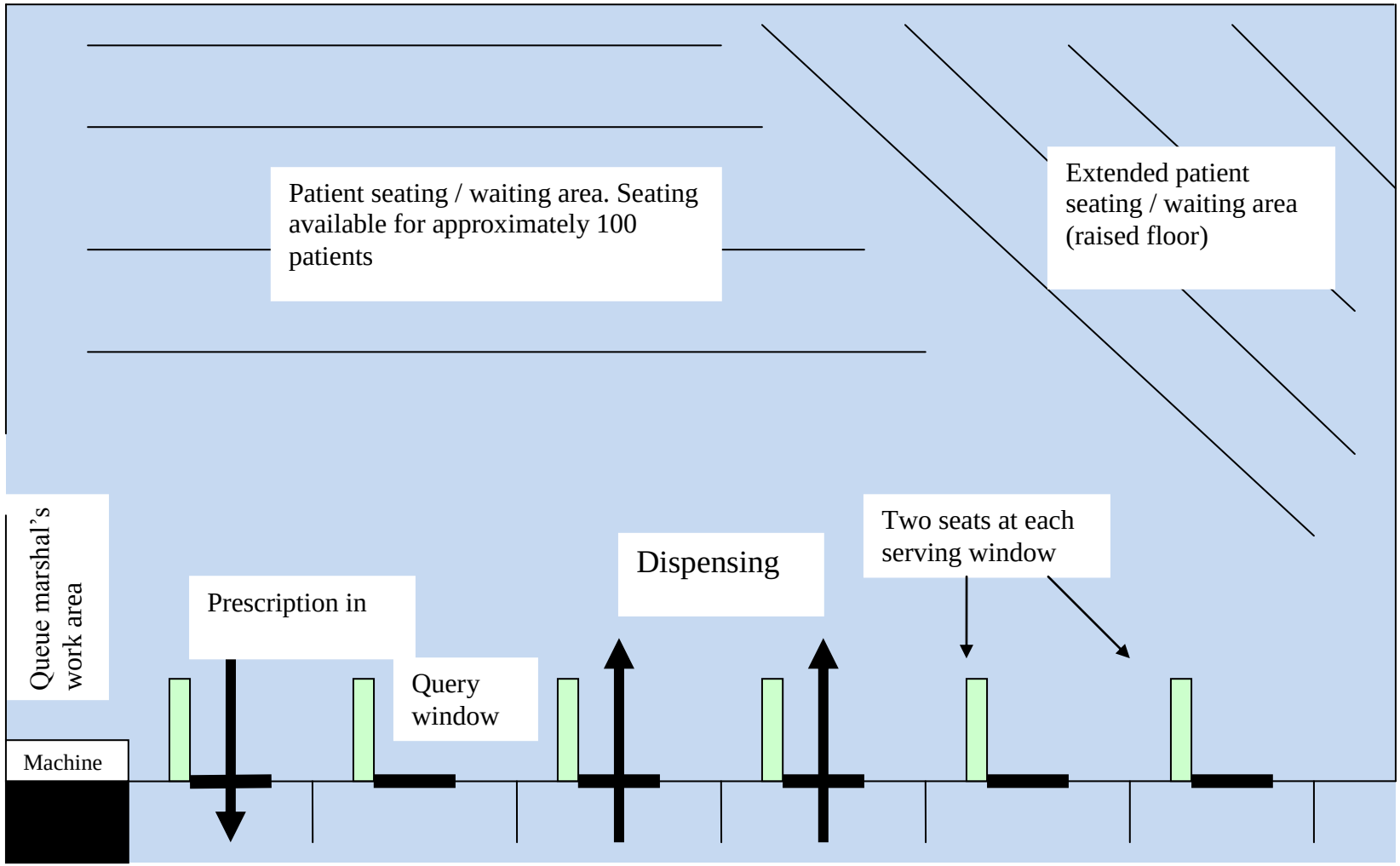
9.5 Annexure 5

Average Daily Workload: SBAH outpatient pharmacy

	Mondays	Tuesdays	Wednesdays	Thursdays	Fridays
Jan-07	533	400	386	430	293
Feb-07	547	495	412	522	359
Mar-07	548	483	480	547	320
Apr-07	584	496	473	579	434
May-07	571	469	498	575	365
Jun-07	468	375	334	468	273
Jul-07	487	422	471	515	332
Aug-07	527	456	474	615	339
Nov-07	702	570	659	639	463
Dec-07	442	544	542	389	296
Jan-08	462	429	342	387	245
Feb-08	514	456	527	518	322
Mar-08	546	513	532	514	371
Average	533	470	471	515	339
Min	442	375	334	387	245
Max	702	570	659	639	463

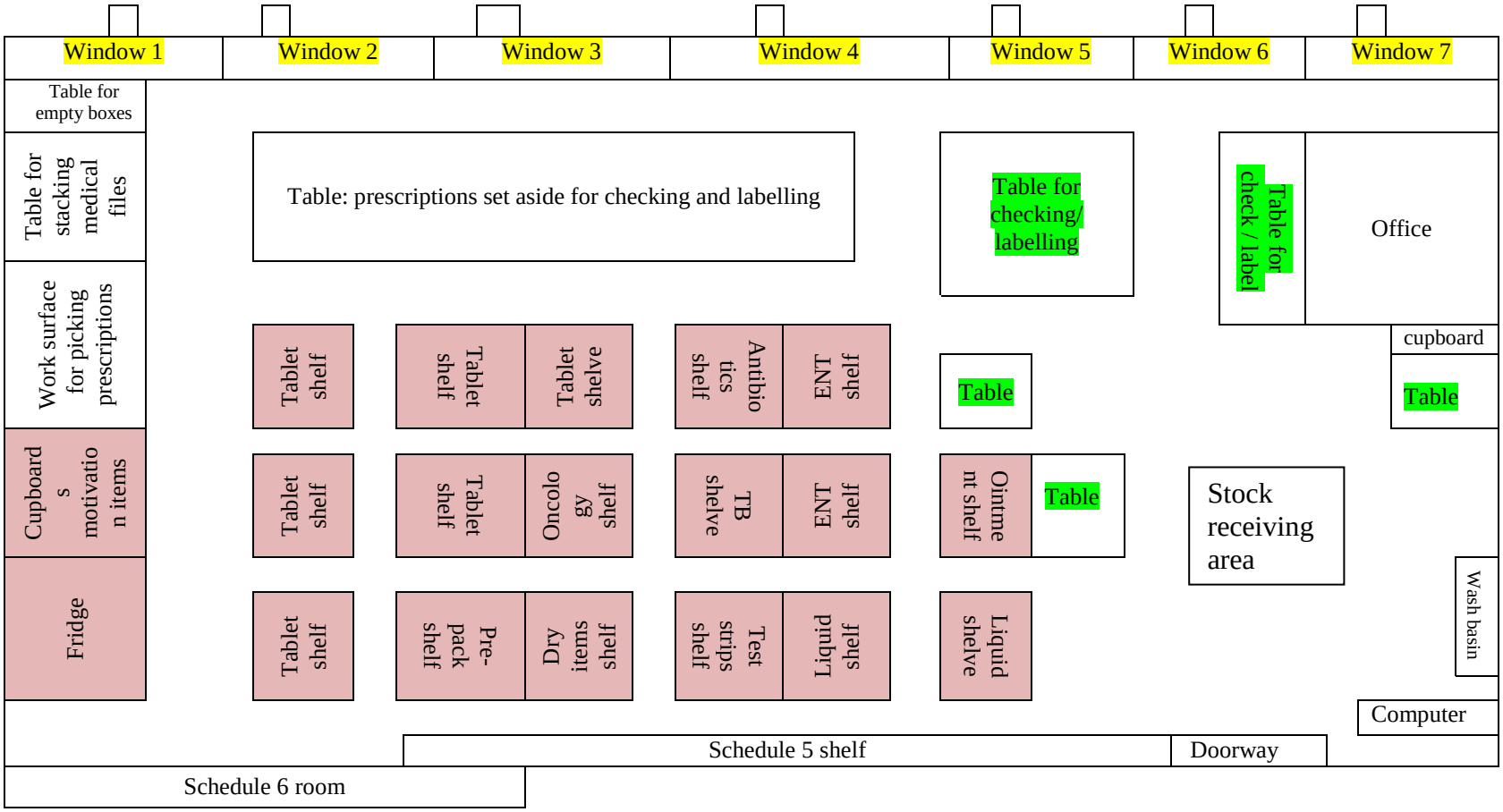
9.6 Annexure 6

Layout of the outpatient pharmacy waiting area



9.7 Annexure 7

Layout of the SBAH outpatient pharmacy



9.8 Annexure 8

Consistency Matrix
Time plan for the for the completion of the research

	Oct 2008	Nov 2008	Dec 2008	Jan 2009	Feb 2009	Mar 2009	Apr 2009	May 2009	June 2009	July 2009
Finalize the proposal for panel	√		OPP fairly quiet and many staff on leave for the festive seasons	OPP extremely busy						
Gain approvals	√									
Briefing sessions	√									
Gather the data		√			√					
Do data analysis					√	√	√	√		
Write report							√	√	√	√
Finalize report										√

Objective number	Objective description	Source of theory (reference)	Source of data (interview/ questionaire data collection forms)	Type of data	Analysis
1	To compare and validate the GDH average waiting time with the average waiting time from the research	Larson (1987) Stevenson (1989) Hillier rand Hillier (2003) GDH (2007) MSH (1997)	Data collection forms: Annexure 1, 2, 3 and 4	Quantitative	Descriptive / inferential / graphical
2	To determine the average arrival rate and the inter-arrival distribution for the prescriptions at the SBAH outpatient pharmacy	Stevenson (1989) Hillier rand Hillier (2003) Pycraft *etal.* (2004)	Data collection forms: Annexure 1, 2, 3 and 4	Quantitative	Descriptive / inferential / graphical
3	To determine the average number of acute, chronic and priority prescriptions seen at the SBAH outpatient pharmacy	Rhodes *etal.* (2003) Hillier and Hillier (2003), Dawson *etal.* (2006), UNHCR (2006), DCSS (2007)	Data collection forms: Annexure 1, 2, 3 and 4	Quantitative	Descriptive / inferential / graphical
4	To determine the average number of line items prescribed per prescription at the SBAH	UNHCR (2006)	Data collection forms: Annexure 1, 2, 3 and 4	Quantitative	Descriptive / inferential / Graphical

Objective number	Objective description	Source of theory (reference)	Source of data (interview/ questionaire data collection forms)	Type of data	Analysis
5	To theoretically determine the number of prescriptions which could be down referred to the primary level of care for clinical management	Rhodes *et al.* (2003) Hillier and Hillier (2003) Dawson *et al.* (2006) UNHCR (2006) GDH (2007) DCSS (2007*)*	Data collection forms: Annexure 1, 2, 3 and 4	Quantitative	Descriptive / inferential / Graphical
6	To determine the average number of medications requiring packing during the dispensing process and the additional time required to pack an item during the dispensing process at the SBAH outpatient pharmacy	MSH (1997) DOH (2003) Pycraft *etal.* (2004) UNHCR (2006)	Data collection forms: Annexure 1, 2, 3 and 4	Quantitative	Descriptive / inferential / Graphical

Objective number	Objective description	Source of theory (reference)	Source of data (interview/ questionaire data collection forms)	Type of data	Analysis
7	To determine the number of prescriptions with an item out of stock and the additional time required manage an out of stock situation at the SBAH outpatient pharmacy	MSH (1997) Hillier and Hillier (2003) Singh V (2006) UNHCR (2006)	Data collection forms: Annexure 1, 2, 3 and 4	Quantitative	Descriptive / inferential / Graphical
8	To determine the service rate, the service distribution and the average number of servers serving the patients at the SBAH outpatient pharmacy	Larson (1987) Stevenson (1989) Kumar *etal.* (1997) MSH (1997) Fijutsi (2000-2005) Hillier and Hillier. (2003) Hongoro, C. and McPake. (2004) CSZ (2007) Pycraft *etal.* (2004) McQuitty *etal.* (2005)	Data collection forms: Annexure 1, 2, 3 and 4	Quantitative	Descriptive / inferential / Graphical

Objective number	Objective description	Source of theory (reference)	Source of data (interview/ questionaire data collection forms)	Type of data	Analysis
9	To determine the average number of errors made during the dispensing process and the additional time required to rectify an error at the SBAH outpatient pharmacy	MSH (1997) RSA (1997) Al- Shakhaa and Zaira, (1998) Pycraft *etal.* (2004) UNHCR (2006) Cronin (2007)	Data collection forms: Annexure 1, 2, 3 and 4	Quantitative	Descriptive / inferential / Graphical
10	To observe the workflow, layout, attitude of staff and other interruptions affecting the supply of pharmaceutical services at the SBAH outpatient pharmacy	Du Plessie (2007) Al- Shakhaa, W.A. and Zaira, M. (1998) Afolabi, O.A. and Erhun, W.O. (2003) Bell, J. (2005)	Data collection forms: Annexure 1, 2, 3 and 4	Qualitative	Descriptive / inferential / Graphical/ Schematic