SURGICAL INFECTIONS AT A REGIONAL HOSPITAL IN GAUTENG: REASONS FOR DELAY TO CARE AND PROFILE OF PATHOLOGY

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Declaration

I, Nirav Patel, declare that this report is my own work. It is being submitted for the degree of Master of Medicine in the branch of Surgery in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

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Signature of candidate

_____day of _____2018

Dedication

To my family who make all of my success possible

Presentations arising from this study

- Surgical Research Society of Southern Africa, Johannesburg, July 2017, Presentation

Publications arising from this study

- Patel N, Candy G, Jann-Kruger C (2017). Surgical infections at a regional hospital in Gauteng: Reasons for delay to care and profile of pathology. *S Afr J Surg* 55(2): 67.

Abstract

Objectives

Present on arrival infection is a common indication for admission in surgical patients initially managed at primary care level. We aimed to describe the demographic and disease profile of patients with infection requiring surgical management, describe determinants of patients' health seeking behaviour and identify barriers to care.

Methods

A prospective descriptive questionnaire based study was conducted at Edenvale General Hospital between February 2014 and October 2016. Minors were excluded.

Results

Eighty nine patients participated. Abscesses (26%, 23/89), diabetic foot (22%, 20/89), and cellulitis (16%, 14/89) were the largest categories of infection necessitating admission. The majority of patients were South African (88%, 78/89), Black African (82%, 73/89), males (58%, 52/89), without medical aid (99%, 88/89), who were not formally employed (58%, 52/89), were from poor households (74%, 73/89), inhabited some form of formal housing (90%, 80/89), were in charge of decisions regarding personal health (80%, 71/89), and first sought help at the primary care level (71%, 62/89). Delay from onset of symptoms to presentation was noted in 69% (61/89) of patients, and delay from presentation to referral to specialist care in 46% (41/89) of patients. Age, race, history of diabetes, and main source of monthly income were significant variables in delayed presentation ($p<0.05$), and age and level of care on first contact in delayed referral ($p<0.05$). The most common reason for delay to presentation (84%, 51/61) and referral (61%, 25/41) was patients' own belief that the problem would get better spontaneously.

Conclusions

Patients' socio-economic status, past medical history, demographics, level of first contact with the health care system, and perceptions of their own health contributed to delays in seeking and receiving care. Barriers to care may be addressed by improvements targeting issues of availability, accessibility, acceptability and affordability of health care services.

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List of Abbreviations

EGH:	Edenvale General Hospital
LMICs:	Low- and Middle- income countries
SSA:	Sub-Saharan Africa
DALY:	Disability Adjusted Life Year
HEAD:	Health, Environment and Development
CMJAH:	Charlotte Maxeke Johannesburg Academic Hospital
RVD:	Retroviral Disease
HIV:	Human Immuno Deficiency Virus
AIDS:	Acquired Immune Deficiency Syndrome
WHO:	World Health Organisation
SOAP:	Sepsis Occurrence in Acutely Ill Patient

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CHAPTER 1

Introduction and literature review

1.1 Background

Present on arrival infection is a common indication for admission in surgical patients. There is a paucity of data on barriers to care for patients with sepsis acquired in the out of hospital setting, and requiring surgical management in public hospitals in Gauteng. Anecdotally, it has been found that numerous patients admitted to our wards for infections requiring surgical management are first seen and treated at primary care level. We aim to describe the demographic and disease profile of patients with infection requiring surgical management, describe determinants of patients' health seeking behaviour and identify barriers to care in the study setting. An understanding of these factors is imperative to formulating appropriate interventions that strengthen the health care system and fulfilling the basic human rights of all individuals[1].

1.2 Literature review

Notwithstanding the fact that public health initiatives have traditionally focused on areas such as health education, infectious disease and maternal and child health, surgically treatable disease constitutes approximately 11% of the total global burden of disease[2,3,4]. The majority of this burden is constituted by injury and malignancies, and their management is an increasingly important concern of health systems[2,4]. Of the estimated 234 million surgical procedures performed each year, only 3.5% are performed amongst the poorest one third of the global population[3]. This disparity is further illustrated in data that reveals that a developing country such as Ethiopia performs only 1% of the total surgical procedures per 100 000 population as a more developed country such as Hungary[4]. The reasons for this grossly unequal distribution of care are multifaceted, but may be broadly thought of in terms of barriers to the availability, accessibility, affordability and acceptability of surgical care in Low- and Middle- income countries (LMICs)[3,4,5]. Within literature, there is a body of work demonstrating the significance of access to safe surgery as a public health issue and its relative cost effectiveness as a public health intervention[4,6,7]**.** This said, the global burden of surgically correctable disease has received a fraction of the academic and political attention given to other global public health issues[4]**.**

In LMICs it is estimated that access to essential surgery could avert 6% of all preventable deaths[8]. Africa is the region with the highest concentration of surgical disability adjusted life years (DALYs) in the world, accounting for 25 million DALYs annually[6]. As noted by Poenaru et al[9] (2015), late presentation, limited access to appropriate care and delay to surgery are major contributors to surgical DALYs in Africa. It has been demonstrated that basic surgical services compare well with public health initiatives such as vaccination campaigns when provided[6]. For instance, the cost of averting a single surgical DALY is estimated at US $11[6]. This compares favourably to more established public health programmes, such as vaccination campaigns, where the cost of averting a single DALY is estimated at US $5[6]. Delays in accessing healthcare in conjunction with inappropriate treatment leads to a significant economic burden for the individuals affected, their families and entire economies[4,5,6]. Due to the prevalence of surgical problems in Africa, their cost to individuals and economies, and the relative cost effectiveness of basic surgical services, improvements in surgical services can have a profound impact on the overall strength of African health care systems[1].

Existing literature reveals that most patients in Sub-Saharan Africa with emergent and non-emergent surgical problems that are effectively treated in developed countries either fail to visit a health facility, or are treated at facilities with a dearth of human or physical resources[5,6]. Mwende et al[10] (2005) and Idowu and Apemiye[11] (2009) highlight this fact in their study of congenital and developmental cataracts in children in Tanzania and adult primary intracranial neoplasms in Nigeria. Notwithstanding the fact that provision of health care in Sub-Saharan Africa has vastly improved in the previous decades, deficiencies in access to and delivery of appropriate care persist, resulting in potentially serious and irreversible consequences for patients[12]. When patients do present to appropriate facilities for the management of their surgical conditions they are often found to have presented at an advanced stage of disease[1,7]. In their study of appendicitis in rural South Africa, Kong et al[13] (2009) found that their patients experienced significant delays between the onset of symptoms and definitive surgical care. These delays were found to result in major morbidity for the affected individuals[13]. As noted by Mansouri et al[12] (2015) delays to care also result in a considerable burden of direct and indirect costs to public health care systems.

Barriers to receipt of appropriate health care can be divided into four components, namely: accessibility, availability, affordability, and acceptability[4,14]. Acceptability of care is fundamental to delivery of surgical care and revolves around numerous issues including

decision making dynamics, fear of surgery and poor outcomes, cultural beliefs, health awareness and education level[2,3,4,5]. More broadly, acceptability of care may be characterized as the expectations, behaviours, perceptions and attitudes that are fundamental to all medical encounters[14]. Social, cultural and educational barriers to surgical care such as stigma, traditional beliefs about disease processes, and patient understanding of disease processes all impact on the accessibility of care and should be important considerations in formulating surgical public health interventions[4]. For instance, numerous studies of childbirth in LMICs demonstrate that family members rather than the patient's themselves decide when an individual should utilise formal health services[3]. In studies done in Nepal and India, when cataract surgery was described as 'washing of the cataract' as opposed to 'eye surgery' enrollment for surgery increased, demonstrating that the way information is presented is fundamental to the acceptability of health care services[3].

Accessing the healthcare system is referred to as health seeking behavior[10]. Health seeking behavior is dependent on numerous factors, including: educational level, gender inequality, health awareness, infrastructure, poverty, and cultural factors[13]. Delays in delivery of health care can be divided into three broad phases[14]. They are: delays in deciding to seek care, delays in reaching adequate health care facilities, and delays in receiving appropriate and timely care[14]. Understanding of patients' health seeking behavior and barriers to health care are important goals in order to construct targeted quality improvement interventions[13,15].

Availability of health care is a broad concept that encompasses the geographical relationship between patients and appropriate health care facilities; the transport opportunities to gain access to these services; the capacity and motivation of health care providers to deliver a service in accordance with the type and severity of presenting condition; and the nature and extent of health needs of the population seeking care[14]. For the majority of patients, first contact with the health care system occurs at the primary care level. In recognition of this fact, the World Health Organisation (WHO) now includes surgery in its definition of primary care and recognizes that the delivery of surgical services at scale requires functional platforms for primary care[5]. The knowledge and skills of primary care providers, resources available to primary care providers and effective referral systems are significant factors in determining availability of appropriate surgical care[12]. In LMICs weak referral systems, lack of infrastructure, and a shortage of skilled and unskilled surgical and allied health care workers compromises available surgical services at primary and higher levels of care[3,4].

Affordability of care refers to the match between cost of services to patients, and their ability to pay[14]. In many LMICs health care costs are not subsidized by the state or reimbursed by private medical aids. Individuals, their families and broader communities bear the cost of treatment, and as such, individuals requiring care but unable to afford it often do not seek care[4]. The cost of services to patients may be thought of as both direct and indirect costs[3, 14]**.** Direct costs refer to the cost of the health care service itself (for instance, costs of consultation, medication, laboratory tests, transport, meals, and accommodation), whilst indirect costs are the opportunity cost of illness in the form of lost income[3,14]**.** In a study of antenatal care in Ghana it was found that women who knew that delivery was free were 5 times more likely to seek professional care than those that did not[3]**.** Traditional healers that are based within communities and provide cheaper services are often utilized as alternatives to formal health services for various ailments when individuals are unable to afford more formal care[3,4].

Sepsis is a common indication for the admission of surgical patients. Sepsis is defined as systemic illness due to microbial invasion of normally sterile body parts[16]. When sepsis is associated with dysfunction of at least one organ system it is termed severe sepsis, and when accompanied by shock requiring the use of vasopressors, in spite of adequate fluid resuscitation, it is termed septic shock[17]. According to the European Sepsis Occurrence in Acutely Ill Patients (SOAP) study, 24.7 percent of patients admitted to intensive care had sepsis on admission[16]. Further, it was found that patients with sepsis had poorer outcomes than those without sepsis[16]. When sepsis progresses to severe sepsis it is associated with a mortality rate of 25-30%, rising to 40-70% in patients with septic shock[17]. Delay in the treatment of patients with severe sepsis and septic shock is strongly associated with increased rates of in hospital morbidity, mortality and the overall cost of treatment[18,19]. In the United States, the incidence of sepsis is 3 per 1000 population per year, or approximately 750 000 cases annually[17]. Sepsis is among the top 10 causes of death in the United States, is prevalent in all age groups and occurs within the community and inpatient settings[17]. Surgically treatable infectious disease contributes a significant proportion of the disease burden in LMICs[8]. The role of appropriate and timely surgery in the management of these pathologies is increasingly being recognized[8].

No studies on present on admission surgical infection and barriers to care for patients in South African urban hospitals were found. PubMed and Google Scholar were searched using the terms ‘Surgical Infection’, ‘Sub-Saharan Africa’, and ‘Delay to surgery’. The dearth of

information on surgical conditions in Sub-Saharan Africa is also noted by Luboga et al[1] (2009) and Atiyeh et al[2] (2010). Where studies do exist, they focus on particular types of surgical infection such as appendicitis[13,20] or abscesses[21]. Further, these studies provide only sparse details on the pre-hospital management of these conditions, barriers to care, and factors influencing patient health seeking behavior. An understanding of the local profile of surgical infectious pathology and the relative importance of each barrier to care is critical to understanding the surgical needs of our population and the formulation of appropriate intervention strategies[3].

1.3 Study aim and objectives

The objectives of this study are to:

(i) provide a demographic profile of the adult patients admitted with present on admission infections requiring surgical management to Edenvale General Hospital (EGH) through hospital casualty, and transferred to EGH from Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) between February 1 2014 and October 31 2016,

(ii) to describe the categories of surgical infections for which these patients were admitted

(iii) to determine the influence of social demographics on patient health seeking behaviour

(iv) to describe gaps in the management of surgical infections in the out of hospital setting

(v) to describe obstacles to access to health care in the study setting

CHAPTER 2

Methodology

2.1 Research Question

What are the obstacles to seeking and receiving care for patients with infection requiring surgical management in the public sector?

2.2 Research Design

A prospective descriptive questionnaire based study was performed at Edenvale General Hospital (EGH) between 01 February 2014 and 31 October 2016.

2.3 Materials and Methods

The questionnaire focused on patient demographics, health seeking behaviour, and utilisation of health care services. The questionnaire utilised questions developed for the Health, Environment and Development (HEAD) study undertaken by the Medical Research Council of South Africa[22]. In particular, the questionnaire assessed barriers to care in terms of the availability, affordability, and acceptability and accessibility of health care services. Questions targeting the availability of health care focused on issues of transportation. Affordability was assessed through questions on income levels, employment status, housing, possession of medical aid, and family structure and dependents. Patients were asked to provide perceptions of their own health, the ability of the health care system to aid in recovery, and their first point of contact with the health care system in order to gauge acceptability. Accessibility was assessed by enquiry around patients' ability to make decisions regarding their own health.

2.4 Sample

Edenvale General Hospital is a regional hospital in the East of Johannesburg. EGH serves a population of approximately 3 million individuals from the suburbs of Edenvale, Lombardy, Alexandra, Tembisa, Linksfield and their surroundings. EGH is located within 15 kilometres of Charlotte Maxeke Johannesburg Academic Hospital, the tertiary referral centre for EGH, and serves as a step down facility for CMJAH. EGH has 230 beds, 40 of which are dedicated to surgical patients[23].

All patients admitted to EGH surgical wards through EGH casualty during the period between 01 February 2014 and 31 October 2016 with present on admission infections were included in

the study. Those patients down referred to EGH from CMJAH were also included. For the purpose of this study, present on admission infection was defined as any source of sepsis in a patient requiring surgical intervention or management by a surgeon. Qualifying patients were those presenting with infection requiring surgical management as identified by the surgical consultant at EGH. Wound infection was considered present if a patient presented with fever, tenderness, oedema, or a growing margin of erythema around a wound that had a purulent discharge, or painful expanding erythema suggestive of cellulitis[24]. The diagnosis of sepsis was further augmented by biochemical studies demonstrating a White Cell Count (WCC) > $10x10^9$cells/l or < $4x10^9$ cells/l and a C Reactive Protein (CRP) > 20 mg/l, although the final two criteria were not used as definitive features of infection. Minors (all patients 18 years and younger) were excluded.

2.5 Data Collection

Data was collected by the principal investigator and medical officers at EGH through face-to-face completion of the study questionnaire. When required, health care staff within the surgical department were utilised as translators. Patient anonymity was maintained by assigning each patient a study number for data collection purposes.

2.6 Data Analysis

The variables in this study were largely categorical with multiple levels. The categories of data collected covered personal, financial, household, health care and transport demographics. Descriptive statistics were generated using MS Excel®. Statistical analysis was performed using the Student's t, Chi-square and Fisher's exact tests in R®, as well as logistic regression. Any patient presenting to a health care worker more than 48 hours after the onset of symptoms was considered a delayed presentation. Once assessed, any patient presenting for specialist care more than 24 hours after referral was considered a delayed referral. Level of significance was set at the 5% level ($p<0.05$). A Student's t-test was used to test for significant differences in the means of continuous variables between the delay and the no delay to presentation and referral groups. . For categorical variables, the Chi-square test of independence was used to test for significant differences between the delay and the no delay to presentation and referral groups. In cases where the Chi-square test was not appropriate due to low frequency counts, Fisher's exact test was performed instead. Logistic regression was utilized to determine significance between category levels of variables identified as significant in delayed presentation and delayed referral. These results were presented by means of an odds ratio (OR) and 95% confidence interval (CI). The odds ratio (OR) is the odds of being

delayed in the first category sub-group divided by the odds of being delayed in the second category sub-group[25]. The confidence interval is a measure of the precision of the odds ratio[26].

2.7 Ethical Considerations

All patient data was anonymous and confidential. All participants provided written informed consent, participation was voluntary and no participant received material benefit from participation in the study. Permission to conduct this study was received from the Human Research Ethics Committee of the University of the Witwatersrand (Protocol No. M131182) and the Chief Executive Officer of Edenvale General Hospital.

CHAPTER 3

Results

3.1 Study Sample

A total of 95 patients agreed to participate in the study. Of these, 6 were excluded from analysis as they represented extreme outliers (that is, delay to presentation or delay to referral greater than 100 days). These data are summarised in Figure 1.

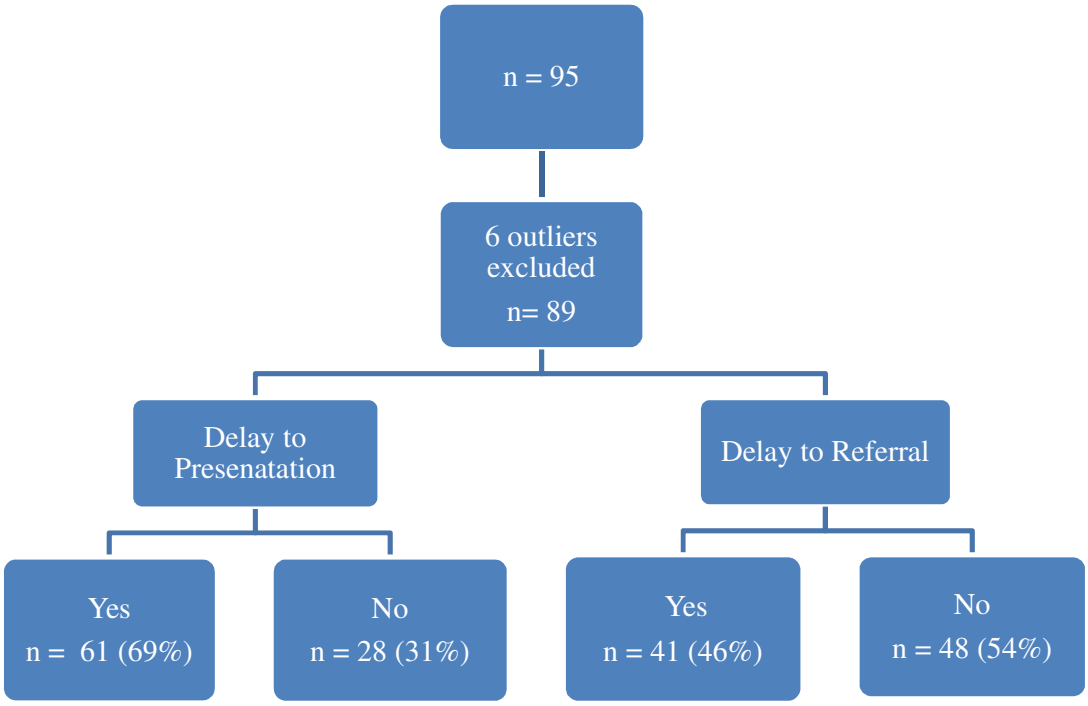

Figure 1. Sample division by delay to presentation and delay to referral

Exclusion of the 6 extreme outliers did not impact on the statistical significance of results. This is evident in the data presented in supplementary tables provided in Appendix 8.8**.**

Abscesses (26%, 23/89), diabetic foot (22%, 20/89), and cellulitis (16%, 14/89) were the most common categories of infection requiring admission. Summary data on category of infection and relative proportion of each diagnosis are presented in Figure 2.

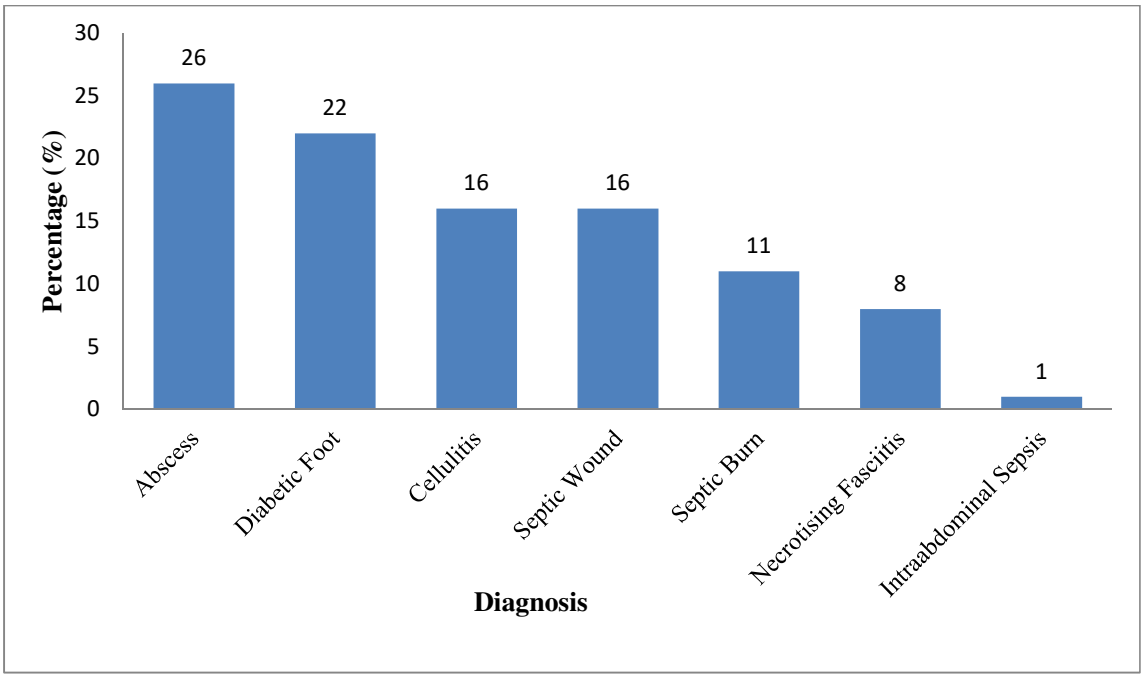

Figure 2. Categories and proportion of surgical infections of study sample

A total of 58% (52/89) of patients were male, 82% (73/89) were Black Africans, and 88% (78/89) were South African citizens. Other demographic data are summarised in Table 1.

Table 1. Demographic, socio-economic and health characteristics of study sample

Category	Category levels	Respondents n (%)
Race	Black	73 (82%)
	Coloured	1 (1%)
	Asian	1 (1%)
	White	14 (16%)
Housing	Formal house	51 (57%)
	Informal dwelling	7 (8%)
	Formal backyard dwelling	12 (13%)
	Informal backyard dwelling	4 (5%)
	Flat	12 (13%)
Employment	Full time	31 (35%)
	Part time	7 (8%)
	Unemployed	40 (45%)
	Piece job	10 (11%)
	Housewife/husband	1 (1%)
Household decision makers	Self	53(60%)
	Partner	1 (1%)
	Head of household	8 (9%)
	Joint decision	27 (30%)

Highest level of education	None	1 (1%)
	Primary	18 (20%)
	Secondary	63 (71%)
	Tertiary	7 (8%)
Main source of monthly income	Formal employment	37 (42%)
	Casual employment	13 (15%)
	Contribution of relatives	10 (11%)
	State grant	28 (31%)
	Casual employment and contribution of relatives	1 (1%)
Monthly household income	<= R1 000	20 (22%)
	R1 001 - R5 000	54 (61%)
	R5 001 - R10 000	10 (11%)
	> R10 000	5 (6%)
Medical aid	Yes	1 (1%)
	No	88 (99%)
Known diabetic	Yes	34 (38%)
	No	55 (62%)
Known RVD	Yes	14 (16%)
	No	66 (74%)
	Blank	9 (10%)
Personal car	Yes	17 (19%)
	No	72 (81%)
Access to public transport	Yes	60 (68%)
	No	19 (21%)
	Blank	10 (11%)
First contact with health care provider	Local clinic	42 (47%)
	Traditional healer	1 (1%)
	Private physician	21 (24%)
	Edenvale General Hospital	24 (27%)
	Blank	1 (1%)

Age was the only continuous variable found to significantly impact time to presentation and time to referral. Relevant subgrouping of significant categorical variables is described below in sections 3.2 and 3.3.

3.2 Delay to presentation

All patients presenting to a health care worker more than 48 hours after the onset of symptoms were considered delayed presenters. Delay to presentation was noted in 69% (61/89) of patients. Mean delay to presentation was 8.5 days (range 0-90 days, standard deviation 3.8 days). Mean age in the delay to presentation group (mean 51.8 years, standard

deviation 14.9 years) was significantly higher (p = 0.019) than mean age in the no delay to presentation group (mean 43.5 years, standard deviation 15.8 years).

Race, history of diabetes and main source of monthly income were identified as significant categorical variables in delay to presentation by the Chi-square and Fisher's exact tests. Race was subdivided into Black Africans and non-Black Africans in order to perform logistic regression. No significant difference was found between these groups (p=0.088, OR: 3.8, 95% CI: 0.98 to 25.8). The relevant Chi-square and Fisher's exact test results (p-values) for personal demographic variables by delay to presentation and the corresponding logistic regression results (p-values), where relevant, are presented in Table 2.

Table 2. Statistical comparison of personal demographics for delay versus no delay to presentation groups

Category	Category levels	No delay n (%)	Delay n (%)	Chi-square/Fisher's exact p-value	Logistic regression p-value
Nationality	South African	23 (25.8%)	54 (60.7%)	0.506	-
	Foreign	5 (5.6%)	7 (7.9%)		
Gender	Male	14 (15.7%)	38 (42.7%)	0.389	-
	Female	14 (15.7%)	23(25.8%)		
Race	Black	26 (29.2%)	47 (52.8%)	0.012	0.088*
	Coloured	0	1 (1.1%)		
	Asian	0	1 (1.1%)		
	White	2 (2.2%)	12 (13.5%)		

*Logistic regression not significant for Black Africans versus non-Black Africans

Table 3 shows the relevant test results for household demographic variables. As can be seen below, household demographics had no significant impact on delay to presentation.

Table 3. Statistical comparison of household demographics for delay versus no delay to presentation groups

Category	Category levels	No delay n (%)	Delay n (%)	Chi-square/Fisher's exact p-value
Housing	Formal house	12 (13.5%)	39 (43.8%)	0.228
	Informal dwelling	4 (4.5%)	3 (3.4%)	
	Formal backyard dwelling	5 (5.6%)	7 (7.9%)	

	Informal backyard dwelling	2 (2.2%)	4 (4.5%)	
	Flat	4 (4.5%)	8 (9.0%)	
	Other	1 (1.1%)	0	
Household decision makers	Self	18 (20.2%)	35 (39.3%)	0.465
	Partner	1 (1.1%)	0	
	Head of household	2 (2.2%)	6 (6.7%)	
	Joint decision	7 (7.9%)	20 (22.5%)	
Highest level of education	None	1 (1.1%)	1 (1.1%)	0.521
	Primary	7 (7.9%)	11 (12.4%)	
	Secondary	19 (21.3%)	43 (48.3%)	
	Tertiary	1 (1.1%)	6 (6.7%)	

Summary data on financial demographics are presented in Table 4. Main source of monthly income was the only significant financial demographic variable identified (p=0.03). Logistic regression was facilitated by subgrouping source of income as Employed (formal and casual employment) and Unemployed (contribution of relatives and state grant). No significant difference was found between these groups (p=0.053, OR: 2.58, 95% CI: 1.0 to 7.1).

Table 4. Statistical comparison of financial demographics for delay versus no delay to presentation groups

Category	Category levels	No delay n (%)	Delay n (%)	Chi-square/ Fisher's exact p-value	Logistic regression p-value
Employment	Full time	7 (7.9%)	24 (27.0%)	0.439	-
	Part time	3 (3.4%)	4 (4.5%)		
	Unemployed	13 (14.6%)	27 (30.3%)		
	Piece job	5 (5.6%)	5 (5.6%)		
	Housewife/husband	0	0		
Main source of monthly income	Formal employment	10 (11.2%)	27 (30.3%)	0.003	0.053*
	Casual employment	10 (11.2%)	3 (3.4%)		
	Contribution of relatives	3 (3.4%)	7 (7.9%)		
	State grant	5 (5.6%)	23 (25.8%)		
	Casual employment and contribution of relatives	0	1 (1.1%)		
Monthly household income	<= R1 000	10 (11.2%)	10 (11.2%)	0.126	-
	R1 001 - R5 000	16 (18.0%)	38		

			(42.7%)		
	R5 001 - R10 000	2 (2.2%)	8 (9.0%)		
	> R10 000	0	5 (5.6%)		
Medical aid	Yes	1 (1.1%)	0	0.314	-
	No	27 (30.3%)	61 (68.5%)		

*Logistic regression not significant for employed versus unemployed

As can be seen below, neither level of care at first contact, nor transport related variables were found to have any significant impact on time to presentation. Whilst personal history of retroviral disease had no impact on time to presentation, personal history of diabetes did. When diabetics were compared with non-diabetics, the odds of diabetics being delayed from onset of symptoms to presentation were 3.1 times greater than those of non-diabetics (p=0.031, OR: 3.1, 95% CI: 1.15 to 9.4). These data are summarized in Table 5.

Table 5. Statistical comparison of health care and transport demographics for delay versus no delay to presentation groups

Category	Category levels	No delay n (%)	Delay n (%)	Chi-square/ Fisher's exact p-value	Logistic regression p-value
Known diabetic	Yes	6 (6.7%)	28 (31.5%)	0.034	0.031**
	No	22 (24.7%)	33 (37.1%)		
Known RVD*	Yes	5 (5.6%)	9 (10.1%)	0.929	-
	No	20 (22.5%)	46 (51.7%)		
	Blank	3 (3.4%)	6 (6.7%)		
Personal car	Yes	2 (2.2%)	15 (16.9%)	0.098	-
	No	26 (29.2%)	46 (51.7%)		
Access to public transport	Yes	21 (23.6%)	39 (43.8%)	0.340	-
	No	6 (6.7%)	13 (14.6%)		
	Blank	1 (1.1%)	9 (10.1%)		
First contact with health care provider	Local clinic	11 (12.3%)	31 (34.8%)	0.768	-
	Traditional healer	0	1 (1.1%)		
	Private physician	8 (9.0%)	13 (14.6%)		
	Edenvale General Hospital	9 (10.1%)	15 (16.9%)		
	Blank	0	1 (1.1%)		

*RVD: Retroviral Disease
**Logistic regression significant for diabetic versus non-diabetic

3.3 Delay to referral

All patients presenting for specialist care more than 24 hours after referral were considered delayed referrals. Delayed referral was noted in 46% (41/89) of respondents. Mean delay to referral was 5.8 days (range 0-60 days, standard deviation 3.0 days). Mean age in the delay to referral group (mean 53.2 years, standard deviation 15.6 years) was significantly higher (p=0.025) than mean age in the no delay to referral group (mean 45.8 years, standard deviation 14.9 years). Level of first contact with the health care system was the only categorical variable identified as significant in time to referral. Table 6 shows the relevant Chi-square and Fisher's exact test results for personal demographic categories by delay to referral. As can be seen, no personal demographics were significant in time to referral.

Table 6. Statistical comparison of personal demographics for delay versus no delay to referral groups

Category	Category levels	No delay n (%)	Delay n (%)	Chi-square/Fisher's exact p-value
Nationality	South African	44 (49.4%)	34 (38.2%)	0.354
	Foreign	4 (4.5%)	7 (7.9%)	
Gender	Male	29 (32.6%)	23 (25.8%)	0.844
	Female	19 (21.3%)	18 (20.2%)	
Race	Black	38 (42.7%)	35 (39.3%)	0.469
	Coloured	9 (10.1%)	5 (5.6%)	
	Asian	1 (1.1%)	0	
	White	0	1 (1.1%)	

Table 7 presents the relevant test results for household demographics. No household demographics were significant in time to referral.

Table 7. Statistical comparison of household demographics for delay versus no delay to referral groups

Category	Category levels	No delay n (%)	Delay n (%)	Chi-square/Fisher's exact p-value
Housing	Formal house	23 (25.8%)	28 (31.5%)	0.223
	Informal dwelling	3 (3.4%)	4 (4.5%)	
	Formal backyard dwelling	9 (10.1%)	3 (3.4%)	
	Informal backyard dwelling	4 (4.5%)	1 (1.1%)	
	Flat	7 (7.9%)	5 (5.6%)	
	Other	2 (2.2%)	0	

Household decision makers	Self	31 (34.8%)	22 (24.7%)	0.090
	Partner	1 (1.1%)	0	
	Head of household	6 (6.7%)	2 (2.2%)	
	Joint decision	10 (11.2%)	17 (19.1%)	
Highest level of education	None	2 (2.2%)	0	0.149
	Primary	6 (6.7%)	12 (13.5%)	
	Secondary	36 (40.4%)	26 (29.2%)	
	Tertiary	4 (4.5%)	3 (3.4%)	

Summary results on financial demographics are presented in Table 8. No financial demographic variables were identified as significant in time to referral.

Table 8. Statistical comparison of financial demographics for delay versus no delay to referral groups

Category	Category levels	No delay n (%)	Delay n (%)	Chi-square/Fisher's exact p-value
Employment	Full time	18 (20.2%)	13 (14.6%)	0.557
	Part time	4 (4.5%)	3 (3.4%)	
	Unemployed	19 (21.3%)	21 (23.6%)	
	Piece job	7 (7.9%)	3 (3.4%)	
	Housewife/husband	0	0	
Main source of monthly income	Formal employment	23 (25.8%)	14 (15.7%)	0.053
	Casual employment	7 (7.9%)	6 (6.7%)	
	Contribution of relatives	8 (9.0%)	2 (2.2%)	
	State grant	10 (11.2%)	18 (20.2%)	
	Casual employment and contribution of relatives	0	1 (1.1%)	
Monthly household income	<= R1 000	14 (15.7%)	6 (6.7%)	0.409
	R1 001 - R5 000	26 (29.2%)	28 (31.5%)	
	R5 001 - R10 000	5 (5.6%)	5 (5.6%)	
	> R10 000	3 (3.4%)	2 (2.2%)	
Medical aid	Yes	1 (1.1%)	0	1
	No	47 (52.8%)	41 (46.1%)	

Level of first contact with health care provider was the only categorical health care variable that significantly impacted on time to referral (p=0.03). Level of first contact was sub-grouped as presentation to EGH and Other. The odds of patients that initially presented to the local clinic, private physician, or traditional healer (Other) experiencing delayed referral to specialist care were 4.7 times greater than those who first presented to EGH (p=0.005, OR: 4.7, 95% CI 1.7 to 15.7). These results are presented in Table 9.

Table 9. Statistical comparison of health care and transport demographics for delay versus no delay to referral groups

Category	Category levels	No delay n (%)	Delay n (%)	Chi-square/ Fisher's exact p-value	Logistic regression p-value
Known diabetic	Yes	14 (15.7%)	20 (22.5%)	0.080	-
	No	34 (38.2%)	21 (23.6%)		
Known RVD*	Yes	7 (7.9%)	7 (7.9%)	0.939	-
	No	36 (40.4%)	30 (33.7%)		
	Blank	5 (5.6%)	4 (4.5%)		
Personal car	Yes	8 (9.0%)	9 (10.1%)	0.717	-
	No	40 (44.9%)	32 (36.0%)		
Access to public transport	Yes	33 (37.1%)	27 (30.3%)	1	-
	No	10 (11.2%)	9 (10.1%)		
	Blank	5 (5.6%)	5 (5.6%)		
First contact with health care provider	Local clinic	21 (23.6%)	21 (23.6%)	0.003	0.005*
	Traditional healer	0	1 (1.1%)		
	Private physician	8 (9.0%)	14 (15.7%)		
	Edenvale General Hospital	19 (21.3%)	4 (4.5%)		
	Blank	0	1 (1.1%)		

*Logistic regression significant for Edenvale General Hospital versus other

3.4 Causes of delay to presentation and referral

The most common reason for delay given by patients in both the delay to presentation (84%, 51/61) and delay to referral group (61%, 25/41) was their belief that their problems would resolve spontaneously. Other reasons for delay to care are reported in Table 10.

Table 10. Reasons for delay to presentation and referral

Reason for delay	Delay to presentation, n = 61, (%)	Delay to referral, n = 41, (%)
Thought problem would resolve itself	51 (83.6%)	25 (60.9%)
Financial constraint	3 (4.9%)	3 (7.3%)
Transport constraint	3 (4.9%)	2 (4.8%)
Fear of health care system	2 (3.3%)	1 (2.4%)
Home responsibilities	1 (1.6%)	5 (12.2%)
Tried alternate therapy	0 (0%)	2 (4.9%)
Blank	1 (1.6%)	3 (7.3%)

CHAPTER 4

Discussion

Abscesses, diabetic foot, and cellulitis were the most common diagnoses requiring surgical management in our series. EGH does not offer an after-hours radiology or surgical service, and this may partially account for the low rate of intra-abdominal sepsis noted in our data. Patients presenting to EGH casualty with suspected intra-abdominal sepsis were likely immediately referred to a higher level of care.

A total of 44% (39/89) of patients in our series were Black African males. El Shallay et al[21] (2012) and Ahmed et al[27] (2000) noted a similar male dominance in their study of community acquired abscesses in Sudan and health seeking behavior in Bangladesh. Notwithstanding the fact that 59% (22/37) of women polled in our sample reported being in charge of decisions regarding their health, women still made up only 42% (37/89) of patients. The preponderance for males to preferentially access health care is a well-known phenomenon and applies to various levels of care in developed and developing countries[28].

Sixty nine percent (61/89) of patients experienced a significant delay from onset of symptoms to presentation. Age, race, main source of monthly income and history of diabetes were significant variables contributing to delay in presentation. Research conducted in the United Kingdom and the United States found that White patients were less likely to experience delays to care than Black and Female patients[29]. On subgroup analysis, we did not find gender, race or economic dependency to be significantly related to delay to presentation. This said, the difference between the economically independent (formal or casual employment as main source of monthly income) and economically dependent (contribution of relatives or the state as main source of monthly income) groups tended to statistical significance ($p=0.053$) in our series. These data imply that the odds of economically dependent patients experiencing a delay to presentation are 2.5 times greater than economically independent patients. Thus, in spite of the availability of free primary care services in the study setting, our data reveals that some groups may encounter financial obstacles to access to care. In their analysis of barriers to surgical care in LMICs, Ologunde et al[4] (2014) identify state grants as a structural disincentive to health seeking behavior. Ologunde et al[4] (2014) argue that since eligibility for disability grants is often related to an individual's disease status, patients with ailments may be reluctant to access available health services in environments characterized by high unemployment and where state grants are an important source of personal and household income[4]. Definitive assertions on this aspect of health seeking behavior are not possible from our data, and this issue warrants further inquiry.

Thirty eight percent (34/89) of the cohort was diabetic. Curiously, history of diabetes was identified as a significant variable contributing to delayed presentation. We found the odds of delayed presentation in diabetics to be 3 times greater than non-diabetics. This may be due to numerous factors including inappropriate health education, inappropriate management of diabetes mellitus and its complications at primary care level, and the acceptability of available care for diabetic patients.

The notion that deficiencies in primary care increase the risk of poorer surgical outcomes is well supported within existing literature. For instance, in a comparative study between Uganda and the United States, 5 year post operative survival from breast cancer was lower at a Ugandan tertiary hospital (56%) than the United States (82-88%)[5]. Inadequate access to appropriate basic care was found to be one of the reasons for this large discrepancy in outcome[5]. In their comparative study of surgery in the management of infectious disease in Sweden and South Africa, Jarnheimer et al[8] (2015) partly attribute the lower frequency of surgery for infectious disease in Sweden to preventative primary care and Sweden's shift to outpatient surgical care. Given the increasing incidence and prevalence of diabetes in South Africa, that diabetic foot was the second most common diagnosis in the cohort, and that diabetic patients are at risk for infection that may require surgical management for multiple reasons, the above findings suggest the need to improve primary care services in the local setting[30,31]. This may be achieved through up skilling of care providers in the public and private primary care sectors, and increasing the range of surgical services available at primary care level.

Task shifting is an emerging concept in the global public health discourse and has been endorsed by the WHO for the expansion of aspects of surgical care[4,5]. Task shifting involves the delegation of tasks normally performed by highly qualified health care workers to less qualified individuals after an appropriate period of training and supervision[32]. Although task shifting does highlight concerns over the quality of surgical care provided, it has been shown to be a successful means of addressing surgical need in a variety of different environments[2,4]. Given that the majority of the surgical workforce in LMICs are paramedical professionals, appropriate and regulated task shifting is an important means to address the immense global unmet burden of surgical disease[4]. In the local context, task shifting may be utilized as a means to improve the surgical acumen and skills of healthcare workers at the primary care level. In this way, primary care may be reinvigorated in order to appropriately prevent, identify, treat and follow up surgical conditions[5]. Notwithstanding improvements in care that may be achieved through task shifting, these advances may only be realized and sustained by

concurrently addressing infrastructure deficits that prevent the delivery of surgical care at primary level[4,5].

Forty six percent (41/89) of the patients in our study experienced a significant delay from presentation to referral. The odds of delayed referral were greater in patients older than the mean age and those whose first contact occurred at the primary care level (in the public or private sectors). In their study of appendicitis in an urban South African population, Nshuti et al[33] (2014) found that delay to receipt of appropriate care was partly due to inappropriate treatment at primary care level. Kong et al[13] (2009) made similar findings in their study of appendicitis in rural South Africa. That said, and in contrast to Kong et al[13] (2009), we did not find lack of transport or patient preference to engage traditional healers to be significant barriers to care in our setting. Given the high rate of utilisation of (public and private) primary care services noted in our study, the high proportion of patients experiencing delays to referral revealed by our data further highlight deficiencies in the management of surgical sepsis at the primary care level noted in other local studies[13,33]. Regardless of the quality of surgical care ultimately provided, poor communication between levels of care, inappropriate primary management, late diagnosis and inadequate screening all adversely affect the outcomes of surgical care[5].

In their study of health seeking behaviour in Bangladesh, Ahmed et al[27] (2000) found that symptom recognition does not automatically result in presentation to a health care facility. The most common reason given by patients for delay to presentation and referral was their perception that their problems would resolve spontaneously. Given that 60% (53/89) of patients in our sample made their own decisions regarding personal health, this finding suggests that acceptability of care is a significant barrier to seeking and receiving care in our environment, and is not unique. Akande et al[34] (2009), in their study of health seeking behaviour in Anyigba, Nigeria, found that more than half of the patients in their series experienced a delay to care due to the assumption that their problems would resolve spontaneously. Given the high proportion of patients with delay to presentation and delay to referral, there is a need to increase health education in communities. In conjunction with broader initiatives such as community health education, relatively simple interventions such as the provision of regular transport from primary care centers to higher level facilities may directly influence time to referral. This is confirmed by a study performed in India, which demonstrated that the provision of transport services significantly increased uptake of services for cataract surgery[3].

CHAPTER 5

Limitations

This was a prospective descriptive study performed at a single centre with variable data collection over a two year period. Thus, the study was limited by its sample size and distribution of respondents over time. Further, and due to the nature of the study design, results may have been influenced by responder bias[35]. Efforts to reduce the potential for this design bias included the use of a validated research tool in the form of the HEAD study questionnaire[22].

CHAPTER 6

Conclusions and Recommendations

The majority of respondents were unemployed, Black African males. Skin and soft tissue infections were the most common diseases requiring surgical management. Delay to presentation and referral was noted in nearly half of all patients. Patients' socio-economic status, past medical history, age, level of first contact with the health care system, and perceptions of their own health were found to contribute to delays in seeking and receiving care. Given that many of the barriers to care found in our study are interlinked, we believe that delays to care may be addressed by a multifaceted intervention strategy addressing the affordability, accessibility, availability and acceptability of health care services. More specifically, and given the results of our study, these interventions may include: (i) health campaigns that specifically target women in order to improve their utilization of health care services, (ii) education programmes on diabetes mellitus, its management and complications for both health care workers at primary level and patients with diabetes mellitus, (iii) improvements in the quality of primary care services that address infrastructural and resource deficiencies and skills deficits, and (iv) interventions to improve the efficiency of referral from primary to higher levels of care.

Future inquiry into barriers to care for patients with infections requiring surgical management may focus on numerous other areas. These include but are not limited to: (i) the perceptions of health care workers on barriers to care at primary and higher levels of care, (ii) assessment of the knowledge of and resources available to primary care workers to manage infectious surgical pathology and chronic disease with surgical complications, and (iii) a review of existing health promotion programmes within the community serviced by EGH.

CHAPTER 7

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CHAPTER 8

Appendices

8.1 Ethics Clearance Certificates with Extensions

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M131182

NAME: (Principal Investigator)	Dr Nirav Patel and Dr J Witt
DEPARTMENT:	Surgery Edenvale General Hospital
PROJECT TITLE:	Admission for Infections in Surgical Patients at Edevale General Hospital, December 2013 - February 2014
DATE CONSIDERED:	29/11/2013
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Dr C Jann Kruger
APPROVED BY:	Professor PE Cleaton-Jones, Chairperson, HREC (Medical)

DATE OF APPROVAL: 13/02/2014

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**.

Principal Investigator Signature M131182Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Nirav Patel
0513068k
niravpatel44@gmail.com
0735589173

15/9/2016

To: Chair, Wits Ethics Committee

Re: Protocol M131182

I would like to please request an extension for the period of data collection of my MMed study to 31/10/2016. Due to clinical commitments, I was unable to complete data collection within the original time frame and need the extra time in order to gather sufficient data.

Sincerely,

Nirav Patel

Human Research Ethics Committee (Medical)

Research Office Secretariat: Senate House Room SH 10005, 10th floor.
Medical School Secretariat: PV Tobias Building 3rd Floor.
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12 January 2017

Dr Nirav Patel
Department of Paediatric Surgery
University of the Witwatersrand

Sent by email to: niravpatel44@gmail.com

Dear Dr Patel

Re: **Protocol Ref no: M131182**
Protocol Title: Admission for Infections in Surgical Patients at Edenvale General Hospital, December 2013 - February 2014
Principal Investigator: Dr Nirav Patel and Dr J Witt
Protocol Amendment: Request to extend study period to 31 October 2016

This letter serves to confirm that the Chairman of the Human Research Ethics Committee (Medical) has approved the protocol amendment for the abovementioned study, as detailed in your letter dated 15 September 2016.

Thank you for keeping us informed and updated,

Yours Sincerely,

UNIVERSITY OF THE WITWATERSRAND
OFFICE OF THE DEPUTY VICE CHANCELLOR RESEARCH
12 JAN 2017
RESEARCH OFFICE HREC (Medical)
JOHANNESBURG

.....L.moeng.....
Mr Lebohang Moeng
Administrative Assistant
Human Research Ethics Committee (Medical)

8.2 Postgraduate Committee Approval

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Private Bag 3 Wits, 2050
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Reference: Ms Thokozile Nhlapo
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06 November 2015
Person No: 0513068K
PAG

Dr N Patel
Po Box 1210
Lenasia
1820
South Africa

Dear Dr Patel

Master of Medicine: Approval of Title

We have pleasure in advising that your proposal entitled *Surgical infections at a regional hospital in Gauteng: Reasons for delay to care and profile of pathology* has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

8.3 Study Protocol

(1) TITLE:

Surgical infections at a regional hospital in Gauteng: Reasons for delay to care and profile of pathology

Candidate:

Dr. N Patel
MMED
0513068K
niravpatel44@gmail.com

Supervisors:

(i) Dr. C Jann-Kruger
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(ii) Professor G Candy
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Head of Research
Department of Surgery, University of the Witwatersrand
Parktown
Johannesburg

(2) BACKGROUND:

Present on arrival infection is an extremely common cause for the admission of surgical patients. There are no studies profiling patients with infections acquired in the out of hospital setting admitted to surgical wards in public hospitals in Gauteng province. Anecdotally, it has been found that numerous patients admitted to our wards for infections requiring surgical management were first seen and treated at primary health care facilities. This study aims to profile those patients admitted to our surgical wards for present on arrival infection in order to understand their pathologies with greater insight, shed some light on the management of these conditions at the primary health care level, deepen our understanding of the health seeking behaviour of our patients, and provide objective evidence of service utilisation for the hospital and surgical department managements.

For the purpose of this study, present on admission surgical infection will be defined as follows: any source of sepsis in a patient requiring surgical intervention or management by a surgeon. Wound infection can be considered to be present when a patient presents with fever, tenderness, oedema, or a growing margin of erythema around a wound that has a purulent discharge, or painful growing erythema suggestive of cellulitis[1].

Sepsis is a common cause for the admission of surgical patients. Sepsis is defined as systemic illness due to microbial invasion of normally sterile body parts[2]. When sepsis is associated with dysfunction of at least one organ system it is termed severe sepsis, and when accompanied by shock requiring the use of vasopressors inspite of adequate fluid resuscitation it is termed septic shock[3]. According to the European SOAP study, 24.7 percent of patients admitted to intensive care had sepsis on admission[2]. Further, it was found that patients with sepsis had poorer outcomes than those without sepsis[2]. When sepsis progresses to severe sepsis it is associated with a mortality rate of 25-30%, rising to 40-70% in patients with septic shock[3]. Delay in the treatment of patients with severe sepsis and septic shock is strongly associated with increased rates of in hospital morbidity, mortality and overall cost of treatment[4,5]. In the United States, the incidence of sepsis is 3 per 1000 population per year, or approximately 750 000 cases annually[3]. Sepsis is among the top 10 causes of death in the United States, is prevalent in all age groups and occurs within the community and inpatient settings[3].

Africa is noted to be the region with the highest concentration of surgical disability adjusted life years (DALYs) in the world[6]. As noted by Poenaru et al[7] (2015), burden of disease estimated through disability adjusted life years resulting from delayed surgery points toward late presentation and limited access to appropriate care. It is estimated that surgical conditions account for 25 million DALYs in Africa annually[6]. It has also been shown that basic surgical services compare well with public health initiatives such as vaccination campaigns (US$11-33/DALY averted relative to US$5/DALY averted) when provided[6]. Delays in accessing healthcare in conjunction with inappropriate treatment leads to a significant economic burden for the individuals affected, their families and entire economies[6]. Mansouri et al[8] (2015) note that the outcome of delays in care impose a significant pressure on patients' families and the patients themselves and result in a significant burden of direct and indirect costs to public health care systems. Due to the prevalence of surgical problems in Africa, their cost to individuals and economies, and the relative cost effectiveness of basic surgical services, improvements in surgical services can have a profound impact of the overall strength of African health care systems[9].

Existing literature reveals that most patients in Sub-Saharan Africa with emergent and non-emergent surgical problems that are effectively treated in developed countries, either fail to visit a health facility or are treated at facilities with a dearth of human or physical resources[6]. Mwende et al[10] (2005) and Idowu and Apemiye[11] (2009) highlight this fact in their study of congenital and developmental cataracts in children in Tanzania and adult primary intracranial neoplasms in Nigeria. Notwithstanding the fact that provision of health care in Sub-Saharan Africa has vastly improved in the previous decades, there persist significant deficiencies in access to and delivery of appropriate care, resulting in potentially serious and irreversible consequences for patients[8]. When patients do present to appropriate facilities for the management of their surgical conditions they are often found to have presented at an advanced stage of disease[6,9]. In their study of appendicitis in rural South Africa, Kong et al[12] (2009) found that their patients experienced significant delays between the onset of symptoms and definitive surgical care. These delays were found to result in major morbidity for the affected individuals[12].

Accessing the healthcare system is referred to as health seeking behavior[10]. Health seeking behavior is dependent on numerous factors, including: educational level, gender inequality, awareness, infrastructure, poverty, and cultural factors[12]. Mansouri et al[8] (2015) note that the knowledge and skills of primary care providers are also a significant factor in determining patients' access to appropriate surgical care. Delays in delivery of health care can be divided into three broad phases[13]. They are: (i) delays in deciding to seek care, (ii) delays in reaching adequate health care facilities, and (iii) delays in receiving appropriate and timely care[13]. Barriers to receipt of appropriate health care can be divided into three components: availability, affordability, and acceptability[13]. Understanding of patients' health seeking behavior and barriers to health care are important goals in order to construct targeted quality improvement interventions[12].

Availability of health care is a broad concept that encompasses: (i) the geographical relationship between patients and appropriate health care facilities, as well as transport opportunities to gain access to these services, (ii) the capacity and motivation of health care providers to deliver a service in accordance with the type and severity of presenting condition, and (iii) the nature and extent of health needs of the population seeking care[13]. Affordability of care refers to the match between cost of services to patients, and their ability to pay, and presents a significant barrier to care due to: (i) price of services at point of delivery, (ii) direct costs associated with transportation, and (iii) indirect costs, such as lost income[13].

Acceptability of care includes the expectations, behaviours, perceptions and attitudes that are fundamental to all medical encounters[13].

No studies on the prevalence of present on admission surgical infections in patients in South African hospitals were found. PubMed and Google Scholar were searched using the terms 'Surgical Infection' and 'Sub-Saharan Africa'. This dearth of information on surgical conditions in Sub-Saharan Africa is also noted by Luboga et al[9] (2009). Where studies do exist, they focus on particular types of surgical infection such as appendicitis[13,14] or abscesses[15]. Further, these studies provide only sparse details on the prehospital management of these conditions, barriers to care, and factors influencing patient health seeking behavior.

(3) AIMS:

The aim of this study is to describe the patients presenting to a South African hospital with sepsis requiring surgical intervention over a period of time.

(4) OBJECTIVES:

(i) provide a demographic profile of the adult patients admitted with present on admission infections requiring surgical management to Edenvale General Hospital (EGH) through hospital casualty and transferred from CMJAH between October 1, 2015 and March 31, 2016,

(ii) to describe the categories of surgical infections for which these patients were admitted

(iii) to determine the influence of social demographics on patient health seeking behaviour

(iv) to describe gaps in the management of surgical infections in the out of hospital setting

(v) to describe obstacles to access to health care in the study setting

(5) METHODOLOGY:

This will be a prospective descriptive study reporting quantitative statistics. All patients admitted to EGH surgical wards through EGH casualty during the period 01/10/15-31/03/16, with present on admission infections will be included in the study. Those patients transferred to EGH from CMJAH will also be included in this study. For the purpose of this study, present on admission infection will be defined as follows: any source of sepsis in a patient requiring surgical intervention or management by a surgeon. Wound infection can be considered to be present when a patient presents with fever, tenderness, oedema, and a growing margin of erythema around a wound that has a purulent discharge, or painful expanding erythema suggestive of cellulitis[1].

This diagnosis can be further augmented by biochemical studies demonstrating a White Cell Count (WCC) > $10x10^9$cells/l or < $4x10^9$ cells/l and a C Reactive Protein (CRP) > 20 mg/l, although the final two criteria are not definitive features of infection. Patients initially admitted to EGH surgical wards with surgical wound infections, but referred to more specialised centres for further management will also be included in the study.

Edenvale General Hospital is a regional hospital with 230 beds located in the north east of Johannesburg. Of these 230 beds, 30 are dedicated to the department of surgery. The patient catchment area for EGH hospital encompasses the suburbs of Edenvale, Lombardi, Alexandra, Tembisa, Linksfield and their surroundings. The hospital serves a population of approximately 3 million individuals and is within 15 kilometers of Charlotte Maxeke Johannesburg Academic Hospital (CMJAH), which is Edenvale General Hospital's referral centre. Edenvale General Hospital also serves as a step down facility for patients at CMJAH.

Minors and those individuals unable or unwilling to consent to participate in the study, will be excluded.

Data collection will be performed by completion of the questionnaire found in appendix A, after qualifying patients from all surgical admissions have been identified by the surgical consultant on a daily basis. These questionnaires will be administered and completed by the surgical registrar or medical officer covering the ward, and where necessary, a translator will be utilised. This questionnaire utilizes a number of questions developed for the Health, Environment and Development (HEAD) study undertaken by the Medical Research Council of South Africa[16].

Patient confidentiality will be maintained by assigning each patient a study number for data collection purposes. Patient names will not be captured or stored within the study database. Data will be collected and stored on Microsoft Excel spreadsheet of my personal laptop. Microsoft Excel will also be used to provide descriptive statistics for the discussion of results. A separate record of each patient included in the study, corresponding patient code, and contact details will be made and stored in the surgical consultant's office in a locked desk. This is necessary if additional details not initially captured are required when data analysis is commenced.

Data analysis will be performed by means of descriptive statistics generated from Microsoft Excel. For categorical variables, percentages will be used to describe the data. Where analytical statistics are required, data will be analysed and mean and standard deviation, and/or median and range reported. If necessary, comparison between groups will be facilitated

using a t-test or Mann Whitney test for continuous variables, and chi squared test for discreet variables.

(6) ETHICS:

The research protocol was submitted to the University of Witwatersrand Human Ethics Research Committee for review and approval. Please find attached copy of ethics approval certificate. No study participants will be materially rewarded for participation in the study, nor will their treatment while admitted in hospital be affected in any objective way. Written permission to conduct this study from the Chief Executive Officer of Edenvale General Hospital has been received.

Written consent will be obtained by completion of the form presented in Appendix B after the patient has been given the opportunity to read the patient information sheet presented with the questionnaire in Appendix C.

Confidentiality of patient data will be achieved by the means described above.

(7) FINANCIAL AND OTHER CONSIDERATIONS:

No potential conflicts of interest are foreseen. All expenses for the study will be borne by the principal investigator.

(8) RATIONALE:

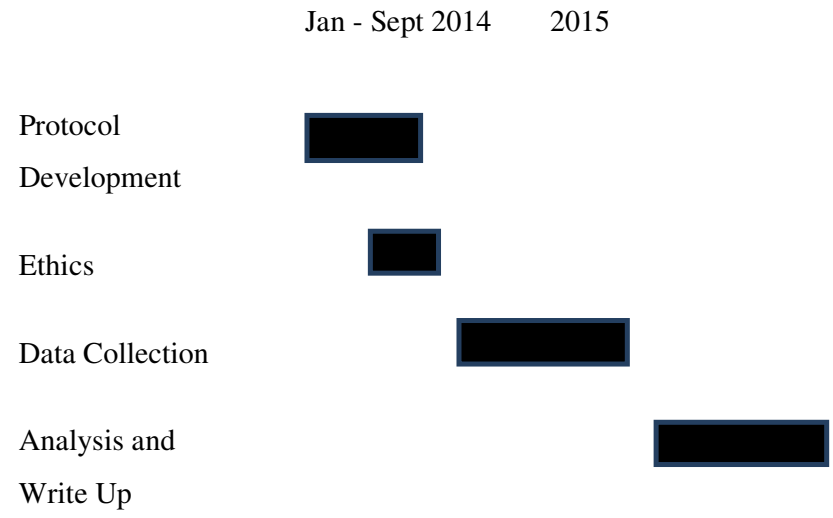
This study is a useful means in which to gauge the prevalence and categories of present on admission infections requiring surgical management, as well as a means to gain insight into the management of these conditions at the primary health care level. The dearth of literature on this topic, also justifies its pursuit. This study is limited by its short duration for data collection, and the fact that it is a single centre study.

(9) OUTPUTS:

Study findings may be disseminated in various ways, including presentation at the annual Bert Myburgh Research Forum hosted by the Department of Surgery at University of the Witwatersrand, the yearly surgical registrars' symposium in 2015, and (if deemed acceptable) within a local peer reviewed journal.

(10) TIME LINE:

Oct-Mar Aprl -Aug 2016



(10) BUDGET:

Printing - R500

Consumables - R500

(11) REFERENCES:

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8.4 Study Questionnaire and Data Sheet

EDENVALE GENERAL HOSPITAL: SURGICAL INFECTION STUDY QUESTIONNAIRE

1 Are you a South African citizen?

Yes	No

2 Which country were you born in? _____

3 Age (in years): _____

4 Gender:

Male	Female

5 Ethnicity:

Black	Coloured	Asian
White	Other	Not Completed

6 Housing:

Formal House	Informal dwelling	Formal Backyard Dwelling
Informal Backyard Dwelling	Flat	Other

7 Employment:

Full time	Part time	Unemployed
Piece Job	Housewife/househusband	

8 Do you have a medical aid?

Yes	No

9 What is your household average monthly income?

<R1000	R1001-R5000
R5001-R10 000	>R10 000

10 What is the main source of monthly income for the household?

Formal employment	Casual employment
Contribution of relatives	State grant

11 What is your highest level of education?

None	Primary
Secondary	Tertiary

12 Who is (are) the person (people) that makes most important decisions in the household?

Yourself	Partner

Head of household	Joint decision

1

13 Are these decision makers:

Male	Female	Male and Female

14 Do you have any of the following conditions?

	Yes	No
Diabetes		
HIV/AIDS		

15 Do you have your own car?

Yes	No

16 If not, do you live close to an established public transport network (bus or taxi)?

Yes	No

17 Are you dependent on others (friends, neighbours, extended family) for transport?

Yes	No

18 Where did you first seek help?

Local clinic	Tradtional Healer
Private Physician	Edenvale General Hospital

19 With what were you treated?

Medication	Dressings
Medication and Dressings	Antibiotics

20 How many days did you take after you first fell ill to seek help, in days?

21 If there was a delay between onset of symptoms and seeking help, what caused the delay?

No money	No transport	Fear of health facility
Home responsibilities	Thought problem would get better	

22 How many days after you first sought help were you admitted, in days?

2

23 If there was a delay between being referred to the hospital and admission, what caused the delay?

No money	No transport	Fear of health facility
Home responsibilities	Thought problem would get better	
Decided to try alternate therapy		

24 Who referred you to Edenvale Hospital:

Local clinic	Private physician	Traditional healer
Self referral		

FOR DOCTOR TO COMPLETE

25 Diagnosis:

Abscess	Cellulitis	Septic Wound
Intraabdominal Sepsis	Necrotising Fasciitis	Septic Burn
Diabetic Foot	Other, specify details	

26 Location of infection

DATA SHEET

1 Study Number
2 South African Citizen
3 Country of Birth
4 Gender
5 Ethnicity
6 Housing
7 Employment
8 Medical Aid
9 Household income
10 Main source of monthly household income
11 Level of Education
12 Household decision makers
13 Chronic conditions
14 Gender of household decision makers
15 Personal Car
16 Access to public transport
17 Dependent on others for transport
18 First sought help
19 Treatment
20 Delay between symptoms and presentation
21 Cause of delay
22 Delay between first consulation and admission
23 Cause of delay
24 Source of referral to hospital
25 Diagnosis
26 Location
27 C Reactive Protein
28 White Cell Count
29 Retroviral disease status

8.5 Patient Information Sheet

Infection in surgical patients at Edenvale General Hospital

Introduction:
Good day/evening,
We, the surgical doctors, are doing research on existing infections upon admission in patients at Edenvale General Hospital. Research is just the way to learn the answer to a question. In this study we want to learn what kinds of existing infections our patients have, where our patients come from and other demographic details, where they first sought help, and for what reasons they may have been delayed in presenting to our hospital.

Invitation to participate: We are asking / inviting you to take part in this research study
What is involved in the study: Involvement in the study requires you to answer some questions. It will take no longer than 15 minutes. Your name will not be recorded in the questionnaire, but you will be assigned a patient code to protect your identity. A separate record of your name, patient code and contact details will be kept in a secure environment if we need to contact you at a later stage. If you agree to participate, you will need to sign a form for informed consent to give us your permission to collect the data. Data will be collected for all patients that agree to be part of the study and analysed as a whole. Currently, no such data exists for patients in South African hospitals. Participation will not influence the management of your condition in any way, nor will it be associated with any financial reimbursement.

There are no risks involved with being in the study as we are simply recording data of your admission to this hospital, the care you receive and the outcome of your condition

The benefit of being in the study is to help us to understand our patients better, in the hopes of providing a better service to future patients. There is no potential benefit to you from participation in this study during this admission.

It is our intention to analyse the data and publish results in an academic journal.
Your involvemt is completely voluntary, and refusal to participate will not impact on your treatment in any way.

If you have any further questions, please contact me at:
niravpatel44@gmail.com
0735589173

In case of queries or complaints that you would prefer not to direct to the researcher, please contact the Human Research Ethics Committee of the University of the Witwatersrand at:
emoso@witshealth.co.za
(011) 274-9280

8.6 Consent form

CONSENT FORM

I……..(participants name), agree to participate in the research study conducted by the surgical department at Edenvale General Hospital.

The research objectives have been explained to me.

I have been informed that all data provided will be confidential, and that this information will be used for research purposes only.

I acknowledge that the findings of this research project may be published in medical and scientific journals.

I recognize that my involvement is voluntary, and that I am free to withdraw my participation at any point without providing any reasons.

Signature: ……. Date:_____/_____/15

8.7 Statistical Calculations and Supplementary Tables

Delay to Presentation

Significant Variables Output:

1. **Race**

```
    Fisher's Exact Test for Count Data

data:  delay1_race_no
p-value = 0.01185
alternative hypothesis: two.sided
```

2. **Known Diabetic**

```
    Fisher's Exact Test for Count Data

data:  delay1_diabetic_no
p-value = 0.03496
alternative hypothesis: two.sided
```

3. **Main Source of Income**

```
    Fisher's Exact Test for Count Data

data:  delay1_incomesource_no
p-value = 0.003153
alternative hypothesis: two.sided
```

Age:

```
    Two Sample t-test

data:  data_nodelay$AGE and data_delay$AGE
t = -2.3913, df = 86, p-value = 0.01897
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -15.199812  -1.400188
sample estimates:
mean of x mean of y
     43.5      51.8
```

Logistic Regression

The variables identified by the Fisher's exact Test as significant ($p<0.05$) were used as explanatory variables in binary logistic regression. Screenshots of the logistic regression R output are below.

1. **Race:**

The race categories were further grouped as Black-African versus Non-Black African. The below output shows that there is no significant difference (p=0.088, OR: 3.8, 95% CI: 0.98 to 25.8) in the likelihood of delay from onset to presentation for Black-Africans and Non-Black Africans.

```
> delay1_tab=read.delim("Documents/LogNoOutliersDelay1Grouped.txt",header=T)
> race.f=factor(delay1_tab$ETHNICITY,labels=c("Black African","Non-Black African"))
> contrasts(race.f)=contr.treatment(2)
> summary(glm(delay1_tab$DELAY1~race.f,family=binomial(link='logit'),data=delay1_tab))

Call:
glm(formula = delay1_tab$DELAY1 ~ race.f, family = binomial(link = "logit"),
    data = delay1_tab)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-2.0393  -1.4369   0.9384   0.9384   0.9384

Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)   0.5921     0.2444   2.422   0.0154 *
race.f2       1.3539     0.7945   1.704   0.0884 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 110.85  on 88  degrees of freedom
Residual deviance: 107.13  on 87  degrees of freedom
AIC: 111.13

Number of Fisher Scoring iterations: 4
```

```
> race_odds
(Intercept)     race.f2
   1.807692    3.872340
> race_int
                2.5 %    97.5 %
(Intercept) 1.1294416  2.958065
race.f2     0.9802091 25.881695
```

2. **Source of Income:**

The income source categories were further grouped as Employed (Formal and Casual) versus Unemployed. The below output shows that the difference in the likelihood of delay from onset to presentation for the Employed and Unemployed is close to being significant (p=0.053, OR: 2.58, 95% CI: 1.0 to 7.1).

```
> source.f=factor(delay1_tab$SOURCE,labels=c("Employed","Unemployed"))
> contrasts(source.f)=contr.treatment(2)
> summary(glm(delay1_tab$DELAY1~source.f,family=binomial(link='logit'),data=delay1_tab))

Call:
glm(formula = delay1_tab$DELAY1 ~ source.f, family = binomial(link = "logit"),
    data = delay1_tab)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-1.7800  -1.3537   0.6776   1.0108   1.0108

Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)   0.4055     0.2887   1.405    0.160
source.f2     0.9491     0.4905   1.935    0.053 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 110.85  on 88  degrees of freedom
Residual deviance: 106.88  on 87  degrees of freedom
AIC: 110.88

Number of Fisher Scoring iterations: 4
```

```
> source_odds
(Intercept)   source.f2
   1.500000    2.583333
> source_int
                 2.5 %   97.5 %
(Intercept) 0.8577828 2.680146
source.f2   1.0148895 7.067145
```

Known Diabetic:

Diabetics were compared to Non-Diabetics. The below outputs show that diabetics had greater odds of delayed presentation than non-Diabetics (p=0.031, OR: 3.1, 95% CI: 1.15 to 9.4).

```
> diab.f=factor(delay1_tab$CHRONIC1,labels=c("Yes","No"))
> contrasts(diab.f)=contr.treatment(2)
> summary(glm(delay1_tab$DELAY1~diab.f,family=binomial(link='logit'),data=delay1_tab))

Call:
glm(formula = delay1_tab$DELAY1 ~ diab.f, family = binomial(link = "logit"),
    data = delay1_tab)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-1.8626  -1.3537   0.6231   1.0108   1.0108

Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)   1.5404     0.4499   3.424 0.000617 ***
diab.f2      -1.1350     0.5274  -2.152 0.031391 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 110.85  on 88  degrees of freedom
Residual deviance: 105.72  on 87  degrees of freedom
AIC: 109.72

Number of Fisher Scoring iterations: 4
```

```
> diab_odds
(Intercept)      diab.f1
   1.500000     3.111111
> diab_int
                 2.5 %    97.5 %
(Intercept) 0.8802522 2.606590
diab.f1     1.1588119 9.422496
```

Delay to Referral

Significant Variables Output:

1. **First Contact with Health Care Provider**

```
        Fisher's Exact Test for Count Data

data:  delay2_contact_no
p-value = 0.003327
alternative hypothesis: two.sided
```

2. **Age:**

```
    Two Sample t-test

data:  data_nodelay$AGE and data_delay$AGE
t = -2.2751, df = 86, p-value = 0.02539
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -13.8816946  -0.9349721
sample estimates:
mean of x mean of y
 45.79167  53.20000
```

Logistic Regression

First Contact with Health Care Provider:

Health care provider categories were further grouped as Edenvale General Hospital and Other. The below output shows that patients who went to Other health care providers had greater odds for delayed referral than those who first went to Edenvale (p=0.005, OR: 4.7, 95%: CI

```
>
> delay2_tab=read.delim("Documents/LogNoOutliersDelay2Grouped.txt",header=T)
> help.f=factor(delay2_tab$HELP,labels=c("Edenvale","Other"))
> contrasts(help.f)=contr.treatment(2)
> summary(glm(delay2_tab$DELAY2~help.f,family=binomial(link='logit'),data=delay2_tab))

Call:
glm(formula = delay2_tab$DELAY2 ~ help.f, family = binomial(link = "logit"),
    data = delay2_tab)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-1.2705  -1.2705  -0.6835   1.0871   1.7712

Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)  -1.3350     0.5026  -2.656  0.00791 **
help.f2       1.5512     0.5612   2.764  0.00570 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 122.83  on 88  degrees of freedom
Residual deviance: 113.92  on 87  degrees of freedom
AIC: 117.92

Number of Fisher Scoring iterations: 4
```

1.7 to 15.7).

```
> help_odds
(Intercept)     help.f2
  0.2631579   4.7172414
> help_int
                 2.5 %     97.5 %
(Intercept) 0.08724541  0.6543156
help.f2     1.66829034 15.6303235
```

Supplementary Table: Delay to Presentation (n = 95)

Category (N=95)	No Delay n(%)	Delay n(%)	p Value
Nationality			0.509
South African	25 (26.3%)	58 (61.1%)	
Foreigner	5 (5.3%)	7 (7.4%)	
Gender			0.595
Male	16 (16.8%)	40 (42.1%)	
Female	14 (14.7%)	25 (26.3%)	
Race			0.011
Black	28 (29.4%)	51 (53.7%)	
White	0	12 (12.6%)	
Coloured	2 (2.1%)	1 (1.1%)	
Asian	0	1 (1.1%)	
Age (Years)			0.018
Mean	43.3	51.7	
Housing			0.653
Formal House	14 (14.7%)	41 (43.2%)	
Informal Dwelling	4 (4.2%)	5 (5.3%)	
Formal Backyard Dwelling	5 (5.3%)	7 (7.4%)	
Informal Backyard Dwelling	2 (2.1%)	4 (4.2%)	
Flat	4 (4.2%)	8 (8.4%)	
Other	1 (1.1%)	1 (1.1%)	
Employment			0.660
Full Time	9 (9.5%)	26 (27.4%)	
Part Time	3 (3.2%)	4 (4.2%)	
Unemployed	13 (13.7%)	28 (29.5%)	
Piece Job	5 (5.3%)	6 (6.3%)	
Housewife/Husband	0	0	
Blank	0	1 (1.1%)	
Medical Aid			0.315
Yes	1 (1.1%)	0	
No	29 (30.5%)	65 (68.4%)	
Known Diabetic			0.022
Yes	6 (6.3%)	30 (31.6%)	
No	24 (25.3%)	35 (36.8%)	
Blank	0	0	
Known RVD			1.00
Yes	6 (6.3%)	12 (12.6%)	

No	21 (22.1%)	47 (49.5%)	
Blank	3 (3.2%)	6 (6.3%)	
Personal Car			0.407
Yes	4 (4.2%)	15 (15.8%)	
No	26 (27.4%)	50 (52.6%)	
Access to Public Transport			0.944
Yes	21 (22.1%)	43 (45.3%)	
No	6 (6.3%)	13 (13.7%)	
Blank	3 (3.2%)	9 (9.5%)	
First Contact With Health Care Provider			0.835
Local Clinic	13 (13.7%)	34 (35.8%)	
Traditional Healer	0	1 (1.1%)	
Private Physician	8 (8.4%)	14 (14.7%)	
Edenvale General Hospital	9 (9.5%)	15 (15.85)	
Blank	0	1 (1.1%)	
Household Decision Makers			0.686
Self	20 (21.1%)	37 (38.9%)	
Partner	1 (1.1%)	1 (1.1%)	
Head of household	2 (2.1%)	6 (6.3%)	
Joint Decision	7 (7.4%)	21 (22.1%)	
Highest Level of Education			0.544
None	1 (1.1%)	1 (1.1%)	
Primary	8 (8.4%)	13 (13.7%)	
Secondary	20 (21.1%)	45 (47.4%)	
Tertiary	1 (1.1%)	6 (6.3%)	
Main Source of Monthly Income			0.018
Formal Employment	12 (12.6%)	29 (30.5%)	
Casual Employment	10 (10.5%)	5 (5.3%)	
Contribution of Relatives	3 (3.2%)	7 (7.4%)	
State Grant	5 (5.3%)	23 (24.2%)	
Casual Employment and Contribution of Relatives	0	1 (1.1%)	
Monthly Household Income			0.236
<R1000	10 (10.5%)	12 (12.6%)	
R1001-R5000	17 (17.9%)	40 (61.5%)	
R5001-10000	3 (3.2%)	8 (8.4%)	
>R10 000	0	5 (5.3%)	

Significant Variables Output:

Race

```
    Fisher's Exact Test for Count Data

data:  delay1_race_no
p-value = 0.01111
alternative hypothesis: two.sided
```

Known Diabetic

```
    Fisher's Exact Test for Count Data

data:  delay1_diabetic_no
p-value = 0.02206
alternative hypothesis: two.sided
```

Main Source of Monthly Income

```
    Fisher's Exact Test for Count Data

data:  delay1_incomesource_no
p-value = 0.01854
alternative hypothesis: two.sided
```

Supplementary Table: Delay to Referral (n = 95)

Category (N=95)	No Delay n(%)	Delay n(%)	p Value
Nationality			0.451
South African	45 (47.4%)	39 (41.1%)	
Foreigner	4 (4.2%)	7 (7.4%)	
Gender			1.00
Male	29 (30.5%)	27 (28.4%)	
Female	20 (21.1%)	19 (20%)	
Race			0.389
Black	39 (41.1%)	40 (42.1%)	
White	9 (9.5%)	5 (5.3%)	
Coloured	1 (1.1%)	0	
Asian	0	1 (1.1%)	
Age (Years)			0.028
Mean	46.0	52.8	
Housing			0.116
Formal House	24 (25.2%)	31 (32.6%)	
Informal Dwelling	3 (3.2%)	6 (6.3%)	
Formal Backyard Dwelling	9 (9.5%)	3 (3.2%)	
Informal Backyard Dwelling	4 (4.2%)	1 (1.1%)	
Flat	7 (7.4%)	5 (5.3%)	
Other	2 (2.1%)	0	
Employment			0.745
Full Time	19 (20.0%)	16 (16.8%)	
Part Time	4 (4.2%)	3 (3.2%)	
Unemployed	19 (20.0%)	22 (23.2%)	
Piece Job	7 (7.4%)	4 (4.2%)	
Housewife/Husband	0	0	
Blank	0	1 (1.1%)	
Medical Aid			1.00
Yes	1 (1.1%)	0	
No	48 (50.5%)	46 (48.4%)	
Known Diabetic			0.145
Yes	15 (15.8%)	21 (22.1%)	
No	34 (35.8%)	25 (26.3%)	
Blank	0	0	
Known RVD			0.794

Yes	8 (8.4%)	10 (10.5%)	
No	36 (37.9%)	32 (33.7%)	
Blank	5 (5.3%)	4 (4.2%)	
Personal Vehicle			0.504
Yes	8 (8.4%)	11 (11.6%)	
No	41 (83.7%)	35 (36.8%)	
Access to Public Transport			0.762
Yes	34 (35.8%)	30 (31.6%)	
No	10 (10.5%)	9 (9.5%)	
Blank	5 (5.3%)	7 (7.4%)	
First Contact With Health Care Provider			0.006
Local Clinic	22 (23.2%)	25 (26.3%)	
Traditional Healer	0	1 (1.1%)	
Private Physician	8 (8.4%)	14 (14.7%)	
Edenvale General Hospital	19 (20.0%)	5 (5.3%)	
Blank	0	1 (1.1%)	
Household Decision Makers			0.122
Self	32 (33.7%)	25 (26.3%)	
Partner	1 (1.1%)	1 (1.1%)	
Head of household	6 (6.3%)	2 (2.1%)	
Joint Decision	10 (10.5%)	18 (18.9%)	
Highest Level of Education			0.159
None	2 (2.1%)	0	
Primary	7 (7.4%)	14 (14.7%)	
Secondary	36 (37.9%)	29 (30.5%)	
Tertiary	4 (4.2%)	3 (3.2%)	
Main Source of Monthly Income			0.073
Formal Employment	24 (25.3%)	17 (17.9%)	
Casual Employment	7 (7.4%)	8 (8.4%)	
Contribution of Relatives	8 (8.4%)	2 (2.1%)	
State Grant	10 (10.5%)	18 (18.9%)	
Casual Employment and Contribution of Relatives	0	1 (1.1%)	
Monthly Household Income			0.576
<R1000	14 (14.7%)	8 (8.4%)	
R1001-R5000	27 (28.4%)	30 (31.6%)	
R5001-10000	5 (5.3%)	6 (6.3%)	
>R10 000	3 (3.2%)	2 (2.1%)	

Significant Variables Output:

First Contact with Health Care Provider

```
    Fisher's Exact Test for Count Data

data:  delay2_contact_no
p-value = 0.006786
alternative hypothesis: two.sided
```

8.8 Turn-it-in Report

ORIGINALITY REPORT

7%	5%	2%	3%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to University of the Western Cape Student Paper	1%
2	pediatrics.aappublications.org Internet Source	<1%
3	Vasan, Ashwin, Carly E. Hudelson, Sarah L.M. Greenberg, and Andrew E. Ellner. "An integrated approach to surgery and primary care systems strengthening in low- and middle-income countries: Building a platform to deliver across the spectrum of disease", Surgery, 2015. Publication	<1%
4	dspace.nwu.ac.za Internet Source	<1%
5	Submitted to University of Wales Institute, Cardiff Student Paper	<1%
6	www.eighty20.co.za Internet Source	<1%

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8.9 Article for submission to the South African Journal of Surgery

Surgical infections at a regional hospital in Gauteng: Reasons for delay to care and profile of pathology

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Abstract

Objectives

Present on arrival infection is a common indication for admission of surgical patients initially managed at primary care level. We aimed to describe the demographic and disease profile of patients presenting with infection requiring surgical management, describe determinants of patients' health seeking behaviour, and identify barriers to care.

Methods

A prospective descriptive questionnaire based study was conducted at Edenvale General Hospital between February 2014 and October 2016. Minors were excluded.

Results

Eighty nine patients participated. Abscesses (26%), diabetic foot (22%), and cellulitis (16%) were the commonest categories of infection necessitating admission. The majority of patients were South African (88%), Black African (82%), males (58%), without medical aid (99%), who were not formally employed (58%), were from poor households (74%), inhabited some form of formal housing (90%), were in charge of decisions regarding personal health (80%), and first sought help at the primary care level (71%). Delay to presentation was noted in 69% of patients, and delay to referral in 46%. Age, race, history of diabetes, and main source of monthly income were significant variables in delayed presentation ($p<0.05$), and age and level of care on first contact in delayed referral ($p<0.05$). The most common reason for delay to presentation (84%) and referral (61%) was patients' belief that their problem would resolve spontaneously.

Conclusions

Patients' socio-economic status, past medical history, demographics, level of first contact with the health care system, and perceptions of their own health contributed to delays in seeking and receiving care. These delays may be addressed by interventions that target the availability, accessibility, acceptability and affordability of health care services.

Introduction

Sepsis is a common indication for admission in surgical patients. Delay in the management of sepsis is strongly associated with increased rates of morbidity, mortality, and the overall cost of treatment[1,2,3]. In low- and middle- income countries (LMICs) estimates suggest that access to essential surgery could avert 6% of all preventable deaths[4]. In Africa, surgical conditions account for 25 million disability-adjusted life years (DALYs) annually[5]. The majority of patients in Sub-Saharan Africa (SSA) with surgical problems fail to visit a health facility, are treated at poorly resourced facilities, or present with advanced disease[2,5,6,7,8]. Infectious conditions constitute a significant portion of the surgical disease burden in LMICs, and the role of appropriate and timely surgery in the management of these diseases is increasingly being recognized[4].

Impediments in seeking, reaching and receiving care may result in delays to care that often result in a significant economic and social burden on affected individuals, their families, society and health care systems[1,5,7,8,9,10]. Barriers to care include educational level, health awareness, gender inequality, poverty, the geographical relationship between patients and health care facilities, confidence in and quality of available services, and the direct and indirect costs of accessing services[7,8,9,11].

There is a paucity of data on barriers to care for patients with sepsis acquired in the out of hospital setting, requiring surgical management, in public hospitals in Gauteng. We aimed to describe the demographic and disease profile of patients with infection requiring surgical management, describe determinants of patients' health seeking behaviour and identify barriers to care. This understanding is imperative to formulating appropriate interventions and strengthening the health care system.

Methodology

Ethical clearance was obtained from the University of the Witwatersrand Human Research Ethics Committee (M131182). A prospective descriptive questionnaire based study was performed at Edenvale General Hospital (EGH) between 01 February 2014 and 31 October 2016. All patients admitted to EGH surgical wards through EGH casualty with present on admission infection requiring surgical management were included in the study. Those patients down referred to EGH from CMJAH were also included. For the purpose of this study, present on admission infection was defined as any source of sepsis acquired in the out of hospital setting requiring surgical intervention or management by a surgeon. Qualifying patients were identified by the surgical consultant at EGH. Minors were excluded.

Edenvale General Hospital (EGH) is a regional hospital in the East of Johannesburg. EGH serves a population of approximately 3 million individuals from the suburbs of Edenvale, Lombardy, Alexandra, Tembisa, Linksfield and their surroundings. EGH is located within 15 kilometres of Charlotte Maxeke Johannesburg Academic Hospital (CMJAH), the tertiary referral centre for EGH, and serves as a step down facility for CMJAH. EGH has 230 beds, 40 of which are dedicated to surgical care[13].

The questionnaire focused on patient demographics, health seeking behaviour, and utilisation of health care services. The questionnaire used questions developed for the Health, Environment and Development (HEAD) study undertaken by the Medical Research Council of South Africa[12]. In particular, the questionnaire assessed barriers to care in terms of the: (i) availability, (ii) affordability, (iii) acceptability and (iv) accessibility of health care services.

All patient data was anonymized and confidential. Participants provided written informed consent, participation was voluntary and no participant received material benefit. Descriptive statistics were generated using MS Excel®. Statistical analysis was performed using the Student's t, Chi-square and Fisher's exact tests in R®. Statistically significant differences

between groups within categorical variables identified as significant by the Chi-square or Fischer's Exact tests were determined using logistic regression. These results are presented by means of an odds ratio (OR) and 95% confidence interval (CI). Any patient presenting to a health care worker more than 48 hours after the onset of symptoms was considered a delayed presentation. Once assessed, any patient presenting for specialist care more than 24 hours after referral was considered a delayed referral. Level of significance was set at $p<0.05$.

Results

A total of 95 patients agreed to participate. 6 respondents were excluded as they represented extreme outliers (that is, delay to presentation or referral greater than 100 days). These data are summarised in Figure 1. Exclusion of the outliers did not impact on the statistical significance of results.

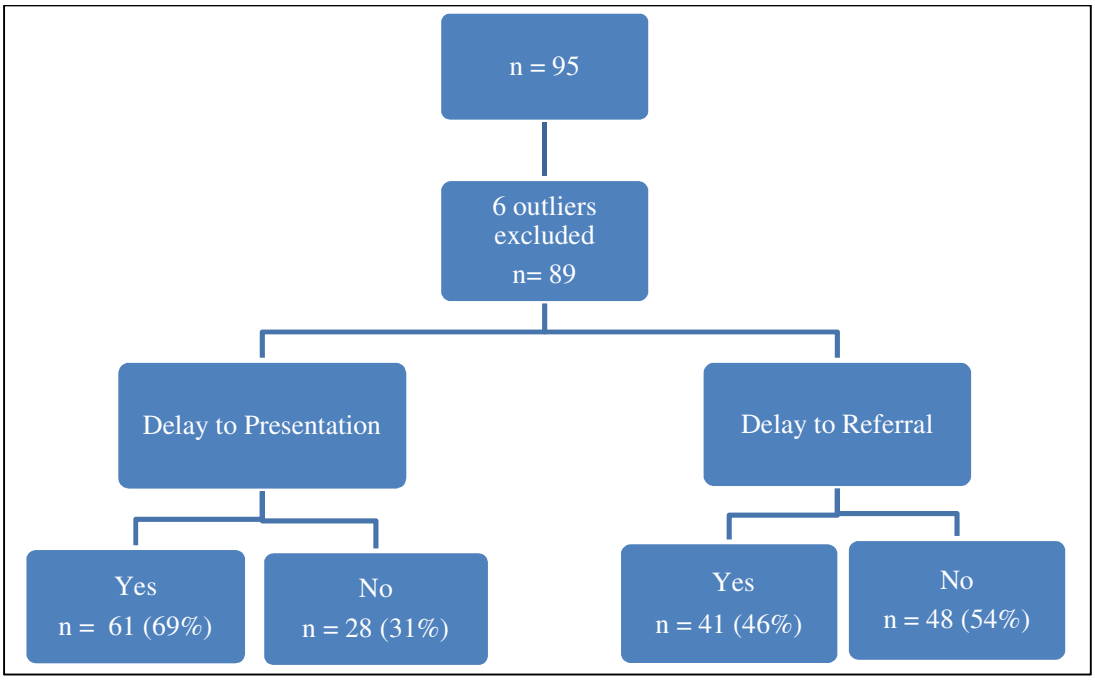

Figure 1: Sample division by delay to presentation and delay to referral

Abscesses (26%), diabetic foot (22%), and cellulitis (16%) were the most common categories of infection requiring admission. Summary data on diagnoses are presented in Figure 2.

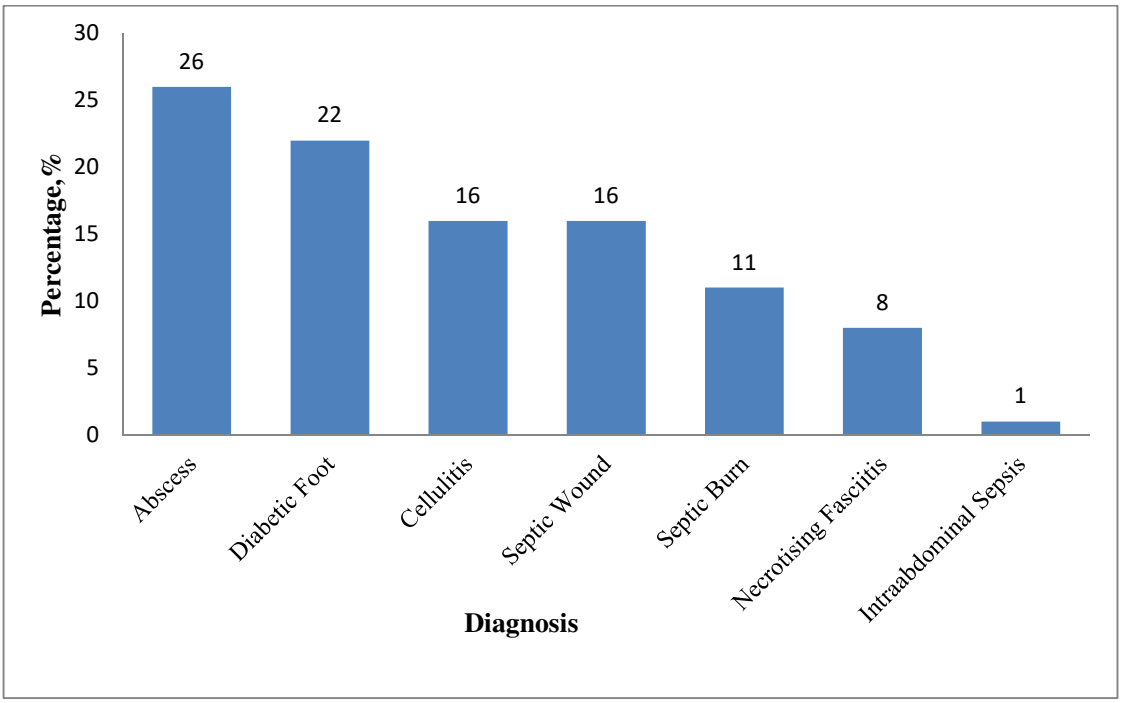

Figure 2: Categories and proportion of surgical infections of study sample

Table 1: Cohort characteristics

Race		**Main Source of Monthly Income**	
Black	73 (82%)	Formal Employment	37 (42%)
Coloured	1 (1%)	Casual Employment	13 (15%)
Asian	1 (1%)	Contribution of Relatives	10 (11%)
White	14 (16%)	State Grant	28 (31%)
Housing		Casual Employment and Contribution of Relatives	1 (1%)
Formal House	51 (57%)	**Monthly Household Income**	
Informal Dwelling	7 (8%)	<R1000	20 (22%)
Formal Backyard Dwelling	12 (13%)	R1001-R5000	54 (61%)
Informal Backyard Dwelling	4 (5%)	R5001-10000	10 (11%)
Flat	12 (13%)	>R10 000	5 (6%)
Employment		**Medical Aid**	
Full Time	31 (35%)	Yes	1 (1%)
Part Time	7 (8%)	No	88 (99%)
Unemployed	40 (45%)	**Known Diabetic**	
Piece Job	10 (11%)	Yes	34 (38%)
Housewife/Husband	1 (1%)	No	55 (62%)
Household Decision Makers		**Known Retroviral Disease**	
Self	53(60%)	Yes	14 (16%)
Partner	1 (1%)	No	66 (74%)
Head of household	8 (9%)	Blank	9 (10%)
Joint Decision	27 (30%)	**First Contact With Health Care Provider**	
Highest Level of Education		Local Clinic	42 (47%)
None	1 (1%)	Traditional Healer	1 (1%)
Primary	18 (20%)	Private Physician	21 (24%)
Secondary	63 (71%)	Edenvale General Hospital	24 (27%)
Tertiary	7 (8%)	Blank	1 (1%)
Access to Public Transport		**Personal Car**	
Yes	60 (68%)	Yes	17 (19%)
No	19 (21%)	No	72 (81%)
Blank	10 (11%)		

Delayed presentation was noted in 69% (61/89) of patients. Mean delay to presentation was 8.5 days (range 0-90 days, standard deviation 3.8 days). Mean age in the delay to presentation group (mean 51.8 years, standard deviation 14.9 years) was significantly higher (p=0.019) than mean age in the no delay to presentation group (mean 43.5 years, standard deviation 15.8 years). Race, history of diabetes and main source of monthly income were identified as significant categorical variables in delay to presentation. Logistic regression was utilized to determine significant differences between groups within categorical variables identified as significant to delayed presentation and delayed referral. Race was subdivided into Black Africans and non-Black Africans in order to perform logistic regression. No significant difference was found between these groups (p=0.088, OR: 3.8, 95% CI: 0.98 to 25.8). Main source of monthly income was the only financial demographic variable identified that significantly impacted on time to presentation (p=0.03). Logistic regression was facilitated by subgrouping source of income as Employed (formal and casual employment) and Unemployed (contribution of relatives and state grant). No significant difference was found between these groups (p=0.053, OR: 2.58, 95% CI: 1.0 to 7.1). Whilst personal history of retroviral disease had no impact on time to presentation, personal history of diabetes did. When diabetics were compared with non-diabetics, the odds of diabetics experiencing delay to presentation were 3.1 times greater than those of non-diabetics (p=0.031, OR: 3.1, 95% CI: 1.15 to 9.4). These results are summarized in Table 2 below.

Table 2: Significant categorical variables in delay to presentation

Category	Category Levels	No Delay n (%)	Delay n (%)	Chi-square/ Fisher's exact p-Value	Logistic Regression p-value
Race	Black	26 (29.2%)	47 (52.8%)	0.012	0.088
	Coloured	0	1 (1.1%)		
	Asian	0	1 (1.1%)		
	White	2 (2.2%)	12 (13.4%)		
Main Source of Monthly Income	Formal Employment	10 (11.2%)	27 (30.3%)	0.003	0.053
	Casual Employment	10 (11.2%)	3 (3.4%)		
	Contribution of Relatives	3 (3.4%)	7 (7.9%)		
	State Grant	5 (5.6%)	23 (25.8%)		
	Casual Employment and Contribution of Relatives	0	1 (1.1%)		
Known Diabetic	Yes	6 (6.7%)	28 (31.5%)	0.034	0.031
	No	22 (24.7%)	33 (37.1%)		

Delayed referral was noted in 46% (41/89) of respondents. Mean delay to referral was 5.8 days (range 0-60 days, standard deviation 3.0 days). Mean age in the delay to referral group (mean 53.2 years, standard deviation 15.6 years) was significantly higher (p=0.025) than mean age in the no delay to referral group (mean 45.8 years, standard deviation 14.9 years). Level of first contact with the health care system was the only categorical variable identified as significant in delay to referral. Level of first contact was sub-grouped as presentation to EGH and Other. The odds of patients that initially presented to the local clinic, private physician, or traditional healer (Other) experiencing delayed referral to specialist care were 4.7 times greater than those who first presented to EGH (p=0.005, OR: 4.7, 95% CI 1.7 to 15.7). These data are summarized in Table 3.

Table 3: Significant categorical variables in delay to referral

Category	Category Levels	No Delay n (%)	Delay n (%)	Chi-square/Fisher's exact p-Value	Logistic Regression p-value
First Contact with Health Care Provider	Local Clinic	21 (23.6%)	21 (23.6%)	0.003	0.005
	Traditional Healer	0	1 (1.1%)		
	Private Physician	8 (9.0%)	14 (15.7%)		
	Edenvale General Hospital	19 (21.3%)	4 (4.5%)		
	Blank	0	1 (1.1%)		

The most common reason for delay given by patients in both the delay to presentation (84%, 51/61) and delay to referral group (61%, 25/41) was their belief that their problems would resolve spontaneously. Reasons for delay to care are reported in Table 4.

Table 4: Reasons for delay to presentation and referral

Reason for delay	Delay to presentation, n = 61, (%)	Delay to referral, n = 41, (%)
Thought problem would resolve itself	51 (83.6%)	25 (60.9%)
Financial constraint	3 (4.9%)	3 (7.3%)
Transport constraint	3 (4.9%)	2 (4.8%)
Fear of health care system	2 (3.3%)	1 (2.4%)
Home responsibilities	1 (1.6%)	5 (12.2%)
Tried alternate therapy	0 (0%)	2 (4.9%)
Blank	1 (1.6%)	3 (7.3%)

Discussion

Abscesses, diabetic foot, and cellulitis were the most common diagnoses requiring surgical management in our series. EGH does not offer an after-hours radiology or surgical service, and this may partially account for the low rate of intra-abdominal sepsis. Patients presenting to EGH casualty with suspected intra-abdominal sepsis were likely immediately referred to a higher level of care. A total of 44% (39/89) of patients in our series were Black African males. El Shallay et al[14] (2012) and Ahmed et al[15] (2000) noted a similar male dominance in their study of community acquired abscesses in Sudan and health seeking behavior in Bangladesh. Notwithstanding the fact that 59% (22/37) of women polled in our sample reported being in charge of decisions regarding their health, women still made up only 42% (37/89) of patients. The preponderance for males to preferentially access health care is a well-known phenomenon and applies to various levels of care in developed and developing countries[16].

Sixty nine percent (61/89) of patients experienced a significant delay from onset of symptoms to presentation. Age, race, main source of monthly income and history of diabetes were significant variables contributing to delay in presentation. Research conducted in the United Kingdom and the United States found that White patients were less likely to experience delays to care than Black and Female patients[17]. On subgroup analysis, we did not find gender, race or economic dependency to be significantly related to delay to presentation. This said, the difference between the employed and unemployed groups tended to statistical significance ($p=0.053$) in our series. These data imply that the odds of unemployed patients experiencing a delay to presentation are 2.5 times greater than employed patients. Thus, in spite of the availability of free primary care services in the study setting, our findings indicate that some groups may face financial obstacles to access to care. In their analysis of barriers to surgical care in LMICs, Ologunde et al[18] (2014) identify state grants as a structural disincentive to health seeking behavior. Ologunde et al[18] (2014) argue that since eligibility for disability grants is often related to an individual's disease status, patients with ailments may be reluctant to access available health services in environments characterized by high unemployment where state grants are an important source of personal and household income. Definitive assertions on this aspect of health seeking behavior are not possible from our data, and this issue warrants further inquiry.

Thirty eight percent (34/89) of the cohort was diabetic. Curiously, history of diabetes was identified as a significant variable contributing to delayed presentation. We found the odds of delayed presentation in diabetics to be 3 times greater than non-diabetics. This may be due to numerous factors including lack of health education, inappropriate management of diabetes mellitus and its complications at primary care level, and the acceptability of available care for diabetic patients. The notion that deficiencies in primary care increase the risk of poorer surgical outcomes is well supported within existing literature. For instance, in a comparative study between Uganda and the United States, 5 year post operative survival from breast cancer was lower at a Ugandan tertiary hospital (56%) than the United States (82-88%). Inadequate access to appropriate basic care was found to be one of the reasons for this large discrepancy in outcome[19]. In their comparative study of surgery in the management of infectious disease in Sweden and South Africa, Jarnheimer et al[4] (2015) partly attribute the lower frequency of surgery for infectious disease in Sweden to preventative primary care and Sweden's shift to outpatient surgical care. Given the increasing incidence and prevalence of diabetes in South Africa, that diabetic foot was the second most common diagnosis in the cohort, and that diabetic patients are at risk for infection that may require surgical management for multiple reasons, the above findings suggest the need to improve primary

care services in the local setting[20,21]. This may be achieved through up skilling of care providers and increasing the range of surgical services available at primary care level in the public and private sectors.

Task shifting is an emerging concept in the global public health discourse and has been endorsed by the World Health Organisation (WHO) for the expansion of aspects of surgical care[19,22]. Task shifting involves the delegation of tasks normally performed by highly qualified to less qualified individuals after an appropriate period of training and supervision[23]. Although task shifting does highlight concerns over the quality of surgical care provided, it has been shown to be a successful means of addressing surgical need in a variety of different environments[22,24]. In the local context, task shifting may be utilized as a means to improve the surgical acumen and skills of healthcare workers at the primary care level. In this way, primary care may be reinvigorated in order to appropriately prevent, identify, treat and follow up surgical conditions[19]. Notwithstanding improvements in care that may be achieved through task shifting, these advances may only be realized and sustained by concurrently addressing infrastructure deficits at primary level[19,22].

Forty six percent (41/89) of the patients in our study experienced a significant delay from presentation to referral. The odds of delayed referral were greater in patients older than the mean age and those whose first contact occurred at the primary care level (in the public or private sectors). In their study of appendicitis in an urban South African population, Nshuti et al[10] (2014) found that delay to receipt of appropriate care was partly due to inadequate treatment at primary care level. Kong et al[7] (2009) made similar findings in their study of appendicitis in rural South Africa. That said, and in contrast to Kong et al[7] (2009), we did not find lack of transport or patient preference to engage traditional healers to be significant barriers to care. Given the high rate of utilisation of (public and private) primary care services noted in our study, the high proportion of patients experiencing delays to referral revealed by our data further highlight deficiencies in the management of surgical sepsis at the primary care level noted in other local studies[7,10]. Regardless of the quality of surgical care ultimately provided, poor communication between levels of care, inappropriate primary management, late diagnosis and inadequate screening all adversely affect the outcomes of surgical care[19].

In their study of health seeking behaviour in Bangladesh, Ahmed et al[15] (2000) found that symptom recognition does not automatically result in presentation to a health care facility. The most common reason given by patients for delay to presentation and referral was their perception that their problems would resolve spontaneously. Given that 60% (53/89) of patients in our sample made their own decisions regarding personal health, this finding suggests that acceptability of care is a significant barrier to seeking and receiving care in our environment. Akande et al[25] (2009), in their study of health seeking behaviour in Anyigba, Nigeria, found that more than half of the patients in their series experienced a delay to care due to the assumption that their problems would resolve spontaneously. Given the high proportion of patients with delay to presentation and referral in our series, there is a need to increase health education in communities. In conjunction with broader initiatives such as community health education, relatively simple interventions such as the provision of regular transport from primary care centers to higher level facilities may directly influence time to referral. This is confirmed by a study performed in India, which demonstrated that the provision of transport services significantly increased uptake of services for cataract surgery[26].

Given that many of the barriers to care found in our study are interlinked, we believe that delays to care may be addressed by a multifaceted intervention strategy addressing the affordability, accessibility, availability and acceptability of health care services. More specifically, these interventions may include health campaigns that specifically target women

in order to improve their utilization of health care services, education programmes on diabetes mellitus, its management and complications for both health care workers at primary level and patients with diabetes mellitus, improvements in the quality of primary care services that address infrastructural and resource deficiencies and skills deficits, and interventions to improve the efficiency of referral from primary to higher levels of care. Future inquiry into barriers to care for patients with infections requiring surgical management may focus on numerous other areas. These include, but are not limited to, the perceptions of health care workers on barriers to care at primary and higher levels of care, assessment of the knowledge of and resources available to primary care workers to manage infectious surgical pathology and chronic disease with surgical complications, and a review of existing health promotion programmes within the community serviced by EGH.

Limitations

This was a prospective descriptive study performed at a single centre with variable data collection over a two year period. Thus, the study was limited by its sample size and distribution of respondents over time. Further, and due to the nature of the study design, results may have been influenced by responder bias.

Conclusions

The majority of respondents were unemployed, Black African males. Skin and soft tissue infections were the most common diseases requiring surgical management. Delay to presentation and referral was noted in 69% (61/89) and 46% (41/89) patients respectively. Patients' socio-economic status, past medical history, age, level of first contact with the health care system, and perceptions of their own health were found to contribute to delays in seeking and receiving care. Given that many of the barriers to care found in our study are interlinked, we believe that delays to care may be addressed by a multifaceted intervention strategy.

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