International Journal of Life Sciences. Vol. 7 No. 3. 2018. Pp. 82-91
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Full Length Research Paper

Predictive Factors for Operating Room Utilization in Elective Orthopedic and Ear Nose and Throat Surgeries at Moi Teaching and Referral Hospital, Eldoret, Kenya

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Article history
Received: 12-04-2018
Revised: 15-04-2018
Accepted: 24-04-2018

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Abstract
Delays in surgery frequently occur in the operating theatre and have a major effect on patient flow and resource utilization. The study aimed to identify predictive factors for operating room utilization in elective orthopedic and ear nose and throat surgeries. The study adopted cross sectional survey design. A total of 290 patients scheduled for elective orthopedic and ENT surgeries were selected to participate in the study using proportional stratified random sampling. Data was collected using observational checklist and analyzed using SPSS Vs.22. The findings have showed that there is a significant difference in the mean start time for the first surgical cases between elective orthopedics and ENT surgeries (t=2.5; df=33; P = 0.02). Orthopedic Theatre was more likely to start conducting first operation earlier. Furthermore, the findings of this study have showed that the type of theatre has a significant association with delay in elective orthopedics and ENT surgeries (t=2.6; DF=108; P = 0.01). The study recommended that the hospital should adopt a policy with clear guidelines on stipulated times for surgical operation, improve on patient preparation at the ward level.

Keywords*: Anesthesia start time, Anesthesia stop time, Arrival time, Operating room utilization, Turnaround time*

Introduction

In acute care hospitals, the operating room is the most expensive area with intense clinical activities, high number of personnel and expensive equipment (Wright, Roche & Khoury, 2010). It is for this reason that efficiency is critical for both profitability and better patient outcome. Additionally, more operations can be performed within a given period of time. In Africa, theater room usage of 48% was depicted by Guerriero *et al*. (2011), and they revealed poor start time and indiscipline as among the elements that determine the usage of the theatre. In Kenya, theater productivity was portrayed by Kirengo *et al*. (2015) that the most punctual patient to be gotten in theater was 8.10 a.m., turnaround time of over 45 minutes and conceivable reasons for delay for the first patient comprise, specialists and anesthetist coming late, poor patient planning, equipment disappointment and delays in surgical setup by nurses. There has been significant need to guarantee that the set theatre strategies are carried on time. Delays that may happen, the theatre can impact the use of operating rooms (Leslie, 2012). In Moi Teaching and Referral Hospital, the number of the theatres is not sufficiently adequate to provide for every one of the patients, consequently requirement for effective operating room usage. This is delineated by the number of patients that have booked to undergo surgeries in the facility, the number of cancellations identified with inaccessible theaters, forthcoming patients who might want to book operations with the facility however can't because of absence of an opening for them to plan their surgeries. The objective of the study was to analyze the mean start time for the first surgical cases in elective orthopedic and Ear nose and throat (ENT) surgeries at the Moi Teaching anf Refferal Hospital (MTRH). Starting of the first procedure that has been scheduled for the day plays a critical role in setting the tone on how the operating room functions.

Materials and Methods

Study area

The study was carried out in Moi Teaching and Referral Hospital. Moi Teaching and Referral Hospital is located in Western region of Kenya in Eldoret town, Uasin Gishu County, Northern Rift Valley. It is about 320 km North West of Nairobi. The hospital is located along the Nandi Road, East of Eldoret town. This site is selected because there is no evidence of a similar study having been done in the study there. The hospital was selected also because it is the second largest national referral health facility in Kenya, and a major hospital in East Africa. It therefore handles a large population.

Sample design

Miles and Huberman (2012) state that research design is a plan for collecting and utilizing data so that desired information can be obtained with sufficient precision. The study adopted a cross-sectional survey design. Prospective study an epidemiologic study in which the groups of individuals (cohorts) are selected on the bases of factors that are to be examined for possible effects on some outcome. For example, the effect of exposure to a specific risk factor on the eventual development of a particular disease can be studied. The cohorts are then followed over a period of time to determine the incidence rates of the outcomes being studied as they relate to the original factors in question. In this way cross-sectional studies employ a single point of data collection for each participant or system being studied. Orodho (2012) notes that it is used for examining phenomena expected to remain static through the period of interest.

Sample population

Study population is a group of individuals taken from the general population who share a common characteristic, such as age, and sex. Target population about which information is desired for the study is derived from the population. The population that is actually surveyed is the study population (Mugenda and Mugenda, 2013). The population of interest in the study consisted of patients scheduled for elective orthopedic and ENT surgeries at Moi Teaching and Referral Hospital. Total number of elective orthopedic and ENT surgeries is 290 patients per month.

Study Population

Specialty	Total number of elective surgery per month
Orthopedic	192
ENT	98
Total	**290**

Source: MTRH Data (2016)

The study included all patients scheduled for elective orthopedic and ENT surgeries and exclude patients coming for elective plastic, pediatrics, and gynecology among other specialties. Also excluded were emergency surgeries. Kothari (2012) defines a sample as part of the target population that has been procedurally selected to represent it. Sampling is the process of systematically selecting representative elements of a population. Proportional stratified random and purposive sampling designs were used in the study. The sample size of the patients was calculated using the formula below as recommended by Fisher *et al.* (2011):

$N = z^2pq/d^2$

Where n= sample size; Z = z value corresponding to a 95% level of significance=1.96; P = expected proportion of population of elective orthopedic and ENT surgeries. There was no preference hence used 50%.

q = (1- p) = (1-0.50) = 0.50

d = absolute precision (5%)

Therefore, from the above sample size is;

$n = 1.96^2*0.50*0.50$

0.05*0.05

n = 0.9604/0.025 = 384

If the sample size is less than 10,000 required sample size was smaller and to calculate final sample size (n) the following formula was used;

$$nf = \frac{n}{1 + \frac{n}{N}}$$

Where

n = Desired sample size (when the population is less than 10,000)

N = Represents the total number of elective orthopedic and ENT surgeries per month = 290

nf = 384/1+(384-1)/290

nf = 1+383/192=2.995

384/2.995=165

The desired sample size comp3333..rised of 165 patients

Plus 10% of 128 to cater for attrition=17 patients

Sample size for the respondents =182 per month.

A sample size of 182 was chosen for the study. The study employed proportional stratified random sampling and purposive sampling.

Data collection methods

The researcher obtained a letter of introduction from the University. Once the research proposal was approved, a research permit was obtained from Masinde Muliro university of Science and Technology and before the researcher proceeded to the Moi Teaching and

Referral Hospital administration to obtain ethical approval from Institutional Research and Ethics Committee (IREC) to conduct the research. Once the ethical approval had been granted, the researcher arranged to visit the respondents within Moi Teaching and Referral Hospital for familiarization purposes and sought permission from the management concerning the intended date of data collection within their organization. After their participation had been confirmed, a date was set and appointment booked with the organization authorities as well as the participants in the study. Training of 2 research assistants was done. The data collection instruments that were used to collect data from the selected respondents were observation checklist being used to collect information on patients scheduled for elective orthopedic and ENT surgeries. Selection of these tools was guided by the nature of data to be collected, time available and objectives of the study. The observation checklist was pretested to ensure reliability of the tool. To ensure Validity, experts were given the tools to review. The participants were given a consent form which informed them of their choice of whether to participate in the study on not. It was only after they consent to take part in the study that the study began. They were given time to respond to all the items in the checklist.

Data analysis

Data analysis is the process of creating order, structure and meaning to the mass of information collected (Mugenda, 2012). Analysis was done using SPSS Version 22 software. The data collected was subjected to test for homogeneity of variables. This indicated whether the data had differences, correlation or categories therefore guiding on making basic decision on how to select the appropriate statistic test. Every specific objective was analyzed separately using specific analytical tool based on the kind of data. This research used descriptive statistics – percentages and mean, chi-square test and ANOVA. The data collected was analyzed using descriptive statistics. Descriptive statistics is the discipline of quantitatively describing the main features of a collection of data which provides simple summaries about the sample and about the observations that have been made (Dodge, 2012). The descriptive statistics that were used included frequencies and percentages. The data collected was analyzed using descriptive statistics to determine the relationships between the variables of the study, chi-square and Pearson correlation to establish the associations between variables and ANOVA to establish the mean difference of the variables. Data was presented using tables, graphs and charts

Results

A total of 171 cases of surgical patients were randomly selected. The cases covered were from 2nd June 2016 to 28th July 2017. More than two-thirds (68.4%) were operated in Orthopedic theatre while 31.6% were operated in ENT theatre. Table 1 shows socio-demographic characteristics of the cases reviewed. Two-thirds (66.1%) were adults aged 14 years and above compared with 33.9% who were children aged 13 years and below. The mean aged was 29.0 with a SD of ±23.0 years. The age range was between 2.0 to 96.0 years. Majority were males (68.4%) in comparison to 31.6% females.

Table 1: Socio Demographic characteristics of patients

Variables	Categories	N	%
Age groups (in years)	0 – 13	58	33.9
	>= 14	113	66.1
Gender	Male	117	68.4
	Female	54	31.6
Total		**171**	**100**

A table indicating the socio demographic characteristics of the patients

Ward Type and Operation

Table 2 presents the ward and type of operation of the cases studied. One in ten cases (11.7%) underwent adenotonsilectomy. This was followed by plating (9.9%) and sign nailing (9.4%). Type of operations under 'Other' was comprised of two or one cases. The leading wards with most of the cases were Ward 5 with 38.6% and Ward 14 with 34.5%. Notably, Ward 14 had only 1.2 cases during the period covered.

Table 2. Ward and type of operation

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Type of operation	Ward						Total
	5	6	8	13	14	15	N (%)
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Adenotonsilectomy	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	20 (33.9)	0 (0.0)	20 (11.7)
Plating	9 (13.6)	0 (0.0)	0 (0.0)	4 (15.4)	4 (6.8)	0 (0.0)	17 (9.9)
Sign nailing	12 (18.2)	0 (0.0)	0 (0.0)	4 (15.4)	0 (0.0)	0 (0.0)	16 (9.4)
K-wiring	2 (3.0)	0 (0.0)	0 (0.0)	0 (0.0)	13 (22.0)	0 (0.0)	15 (8.8)
Adenoidectomy	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	13 (22.0)	1 (50.0)	14 (8.2)
Debridement	7 (10.6)	0 (0.0)	0 (0.0)	0 (0.0)	2 (3.4)	0 (0.0)	9 (5.3)
Dynamic hip screw	6 (9.1)	0 (0.0)	0 (0.0)	2 (7.7)	0 (0.0)	0 (0.0)	8 (4.7)
Examination under anaesthesia and biopsy	0 (0.0)	6 (50.0)	1 (16.7)	0 (0.0)	0 (0.0)	0 (0.0)	7 (4.1)

Hemiarthroplasty	4 (6.1)	0 (0.0)	0 (0.0)	2 (7.7)	0 (0.0)	0 (0.0)	6 (3.5)
Fine endoscopic sinus surgery	0 (0.0)	2 (16.7)	1 (16.7)	0 (0.0)	0 (0.0)	1 (50.0)	4 (2.3)
Skin grafting	4 (6.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (2.3)
Locking plate	1 (1.5)	0 (0.0)	0 (0.0)	2 (7.7)	0 (0.0)	0 (0.0)	3 (1.8)
***Other**	21 (31.8)	4 (33.3)	4 (66.7)	12 (46.2)	7 (11.9)	0 (0.0)	48 (28.1)
Total	**66 (100.0)**	**12 (100.0)**	**6 (100.0)**	**26 (100.0)**	**59 (100.0)**	**2 (100.0)**	**171 (100.0)**

*Other (Types of operation with two or less cases))=Below knee amputation, Total knee replacement, fin nail, flapping, Z-plasty, arthrotomy, arthrotomy and screws, biopsy, biopsy and curettage, core biopsy, corrective osteotomy, dissection, excisional biopsy, exploration, debridement and exofix, direct laryngoscopy, intramedullary nail, hip disarticulation, incision and drainage, instrumentation, knee arthroplasty, mastoidectomy, oesophagoscopy and removal, open reduction, osteotomy, polypectomy, posterior stabilization, radial head excision, removal of exofix, through knee disarticulation, thyroidectomy, total hip replacement, sequestrectomy, stent removal, wide excision and discectomy

Type of surgery and who performed the surgery

Type of surgery and qualifications of who performed the surgery are presented in Table 3 Consultants conducted more than one-half of the operations (56.7%) categorized as major. Of the major operations conducted by consultants, one-in-five (20.6%) were adenotonsillectomy while 15.5% and 14.4% were K-wiring and adenoidectomy, respectively. Nearly one-third (31%) of the cases were handled by both consultants and registrars and fell under major operations. Top among these were sign nailing (18.9%) and plating (17%). Registrars performed 6.4% of the operations classified as major with 27.3% being plating operations. Minor operations comprised of 5.8% of all the operations with registrars performing most of the operations that which included debridement (75%).

Table 3: Type of surgery and who performed the surgery

Type of surgery	Who performed the surgery	Type of operation	Total	
	Consultant		N	%
Major		Adenotonsilectomy	20	20.6
		K-wiring	15	15.5
		Adenoidectomy	14	14.4
		Sign nailing	6	6.2
		Plating	5	5.2
		Dynamic hip screw	4	4.1
		Examination under anesthesia and biopsy	3	3.1
		Hemiarthroplasty	3	3.1
		Locking plate	3	3.1
		Skin grafting	2	2.1
		Fine endoscopic sinus surgery	1	1.0
		Other	21	21.7
		Total	**97**	**100.0**
	Consultants/Registrars	Sign nailing	10	18.9
		Plating	9	17.0
		Dynamic hip screw	4	7.6
		Examination under anesthesia and biopsy	4	7.6
		Fine endoscopic sinus surgery	3	5.7
		Hemiarthroplasty	3	5.7
		Other	20	37.7
		Total	**53**	**100.0**
	Registrar	Plating	3	27.3
		Skin grafting	2	18.2
		Debridement	2	18.2
		Other	4	36.4
		Total	**11**	**100.0**
Minor	Consultant	Debridement	1	50.0
		Other	1	50.0
		Total	**2**	**100.0**
	Registrar	Debridement	6	75.0
		Other	2	25.0
		Total	**8**	**100.0**

Assessing factors associated with delays in use of theatre

T-test was used to examine differences between means. A two-sample t test was used to examine whether the sample mean of identified continuous variable is different between two different groups of individuals or categories. The assumption of equal variance using Pooled method to report the t-test results was used.

Mean start time for the first surgical cases in elective orthopedic and ENT

A comparison between mean start time for the first surgical cases in elective Orthopaedic and ENT surgeries was done. Recommended start time for the operations is supposed to be 8.30 am. Deviations from this start time was calculated using 8.30 am as reference point and differences from the reference time and actual start time calculated and the means derived from the differences. Table 4 present the differences in the means between Orthopaedic and ENT wards.

Study findings showed a significant relationship between age group and delay in first surgery start time. The recommended start time for first surgical patient is supposed to be 8:30 am. Deviations from the expected start time were added up and their mean calculated for each of the independent variables presented in Table 4. Adults aged 14 years and above had a higher mean of 99.2 minutes compared with children aged 13 years and below with a mean of 63 minutes (t=2.5; df=33; P = 0.02). This implies that there was delay of 99.2 minutes with regard to start time for first surgical, adult patients in contrast to children's 63 minutes. Significant results were also obtained when comparing delay in start time for the first surgical patient operated in Orthopaedic and ENT theatres. Orthopaedic Theatre was more likely to start conducting first operation earlier posting a mean on 64.5 minutes as opposed to ENT that start later with a mean of 102.5 (t=2.5; df=33; P = 0.02). No significant relationships were seen between gender, type of surgery, surgeon's qualification and delay in start time for first surgical patients. Delay in start time for the first surgical patient in Orthopaedic Theatre was attributed to two cases of surgeons reporting late.

Table 4: Mean start time for the first surgical cases in elective orthopedic and ENT

Variables	Category	N	Mean	SD	df	t-test	95% CI	P value
Age group	Adult	12	99.2	46.1	33	2.5	69.9 – 128.4	0.02
	Child	23	63.0	37.9			46.5 – 79.4	
Gender	Male	22	72.9	28.2	33	0.4	50.1 – 95.6	0.67
	Female	13	79.6	51.4			62.5 – 96.7	
Surgical Theatres	Orthopaedic	25	64.5	46.4	33	2.5	69.3 – 135.7	0.02
	ENT	10	102.5	38.5			48.6 – 80.4	
Classification of surgery	Major	33	76.9	14.1	33	-0.8	61.1 – 92.7	0.4
	Minor	2	50.0	44.6			-77.1 – 177.1	
Category of surgeon	Consultants	21	78.3	49.9	33	-0.5	51.2 – 90.6	0.6
	Consultants & Registrars	14	70.8	34.2			55.6 – 101.0	

Differences in mean time patient is sent for and porter arrival in the ward

This delay time was calculated based on difference in time patient is sent for and porter arrival in the ward. This excluded patients who were collected by ambulance. Of the five independent variables, namely: age group, gender, name of theatre, classification of surgery and surgeon's category, none had any significant association with delay time (Table 5). Delay in time was caused by lack of transport for patients.

Table 5: Differences **in mean time patient is sent for and porter arrival in the ward**

Variables	Category	N	Mean	SD	df	t-test	95% CI	P value
Age group	Adult	109	4.7	4.3	109	-0.6	3.9 – 5.5	0.6
	Child	2	4.4	0.0005			2.99 – 3.0	
Gender	Male	78	4.8	4.6	109	-0.5	3.8 – 5.9	0.6
	Female	33	4.4	3.6			3.1 – 5.7	
Surgical Theatres	Orthopedic	94	4.7	4.6	109	-0.1	3.8 – 5.6	0.96
	ENT	17	4.6	2.4			3.4 – 5.9	
Classification of surgery	Major	103	4.6	4.4	109	0.5	3.8 – 5.5	0.6
	Minor	8	5.4	2.2			3.5 – 7.2	
	Consultants	41	5.2	3.5	109	-0.99	4.1 – 6.3	0.3
Category of surgeon	Consultants & Registrars	70	4.4	4.5			3.3 – 5.5	

Differences in mean time porter arrived in the ward and when patient is wheeled to theatre

Differences in mean time nurse and porter wheeled patient to theatre and time porter arrived at the ward was determined as shown in Table 6. Results show that patients who were scheduled for major surgeries took a significantly shorter mean time (19.2 minutes) compared with those who scheduled for minor surgery who took much longer with a mean of 43.8 minutes (*t=3.4*; df=109; *P* = 0.001). Theatre preparation for major surgeries are more elaborate compared with that of minor surgeries. Special preference is therefore given patients booked for major surgeries and this is also seen in the time taken to wheel the former to theatre. The rest of the other independent variables had no significant association with delay time porter arrived in the ward and when patient is wheeled to theatre. Poor patient preparation was the main reason for delay wheeling the patient to theatre from the ward.

Table 6: Differences in mean time porter arrived in the ward and when patient is wheeled to theatre

Variables	Category	N	Mean	SD	df	t-test	95% CI	P value
Age group	Adult	109	21.1	20.8	109	-0.6	17.1 – 25.4	0.6
	Child	2	13.0	15.6			126.8 – 152.8	
Gender	Male	78	21.7	21.5	109	-0.6	16.8 – 26.5	0.6
	Female	33	19.2	18.9			12.5 – 25.9	
Surgical theatres	Orthopaedic	94	20.8	19.2	109	0.2	16.8 – 24.7	0.8
	ENT	17	22.0	28.3			7.5 – 36.5	
Classification of surgery	Major	103	19.2	19.4	109	3.4	15.4 – 23.0	**0.001**
	Minor	8	43.8	25.0			22.8 – 64.7	
Category of surgeon	Consultants	41	18.2	19.7	109	1.1	12.0 – 24.4	0.3
	Consultants & Registrars	70	22.6	21.3			17.5 – 27.6	

Differences in mean time patient was sent for and time patient arrived in the receiving area

Analysis on time patient was sent for and time patient arrived in the receiving area was assessed to find out factors associated with delay to receiving area (Table 7). This was calculated as the difference between the time patient was sent for and arrival time in the receiving area. Again, there was significant association between category of surgery and delay in arrival in receiving area. Patients going for major surgeries spent a significantly less mean time of 29.4 minutes in contrast to those going for minor surgeries with a mean of 51 minutes (*t=2.6*; df=108; *P* = 0.01). No other significant results were obtained on age group, gender and name of surgical theatre.

Table 7: Differences in mean time patient was sent for and time patient arrived in the receiving area

Variables	Category	N	Mean	SD	df	t-test	95% CI	P value
Age group	Adult	108	31.0	21.8	108	-0.8	26.8 – 35.6	0.4
	Child	2	18.5	16.3			-127.6 – 164.6	
Gender	Male	77	31.6	23.0	108	-0.6	26.4 – 36.8	0.5
	Female	33	28.8	18.8			22.1 – 35.4	
Surgical theatres	Orthopaedic	93	30.3	20.1	108	0.5	26.2 – 34.5	0.6
	ENT	17	33.1	30.0			17.6 – 48.5	
Classification of surgery	Major	103	29.4	21.0	108	2.6	25.3 – 33.5	0.01
	Minor	7	51.0	25.4			27.5 – 74.5	
Category of surgeon	Consultants	41	27.9	19.9	108	1.0	21.7 – 34.2	0.3
	Consultants & Registrars	69	32.4	22.8			27.0 – 37.9	

Differences in mean time patient was received in receiving area and time patient entered OR

To determine differences in mean time patient was received in receiving area and time patient entered OR was assessed based on difference in arrival at the receiving area and time patient entered the OR room (Table 8). There was significant association between age group, name of surgical theatre and category of surgeon. The relationship between age group and delay in entering OR from receiving area was highly significant with a mean time of 90.8 minutes for adults aged 14 and above years and children aged 13 years and less with a mean time of 154.6 minutes (*t=4.9*; df=168; *P* = <0.0001). Patients being operated in Orthopedic Theatre also took significantly shorter mean time of 96.7 minutes unlike those in ENT Theatre who took 146.7 minutes (*t=3.6*; df=168; *P* = 0.0004). Patients who were to be operated on by consultants/registrars equally took a significantly shorter mean time of 96.6 minutes as opposed to those who were to be operated by consultants with a mean time of 124 minutes (*t=-2.1*; df=168; *P* = 0.04). Notably, gender and type of surgery had no significant bearing on delay in being received in OR room from receiving area.

In ENT Theatre, there three cases where surgeons reported late causing delay in time patients entered receiving area and entering OR. The same was the case with Orthopaedic Theatre where 3 surgeons reported late.

Table 8: Differences in mean time patient was received in receiving area and time patient entered OR

Variables	Category	N	Mean	SD	df	t-test	95% CI	P value
Age group	Adult	112	90.8	73.1	168	4.9	77.1 – 104.5	**< 0.0001**
	Child	58	154.6	95.6			129.5 – 179.7	
Gender	Male	116	112.5	88.1	168	0.0	96.3 – 128.8	1.000
	Female	54	112.6	84.3			89.6 – 135.6	
Surgical Theatre	Orthopaedic	116	96.7	77.6	168	3.6	82.4 – 110.9	**0.0004**
	ENT	54	146.7	95.5			120.6 – 172.8	
Classification of surgery	Major	161	112.9	87.8	168	-0.21	99.2 – 126.6	0.800
	Minor	9	106.6	66.0			55.9 – 157.3	
Category of Surgeon	Consultants	99	124.0	93.9	168	-2.1	105.3 – 142.7	**0.040**
	Consultants & Registrars	71	96.6	73.1			79.3 – 113.9	

Differences in mean time patient entered OR and time anesthesia is started

Differences in mean time patient enters OR and time GA is started can be used as a proxy indicator on time utilization in theatre as illustrated in Table 9. The difference in time between time patient entered in OR and time GA was started was examined and the mean calculated. Results show that children aged 13 years and less took a significantly shorter mean time of 8.7 minutes compared with adult who took a mean of 10.1 minutes in terms of delay in starting GA upon arrival in OR (*t=-0.42*; df=169; P = <0.0001). Gender, surgical theatre, classification of surgery and category of surgeon were not significantly associated with GA lag time.

Table 9: Differences in mean time patient entered OR and time anesthesia is started

Variables	Category	N	Mean	SD	df	t-test	95% CI	P value
Age group	Adult	113	10.1	15.8	169	-0.42	7.1 – 13.0	**<0.0001**
	Child	58	8.7	26.6			1.7 – 15.7	
Gender	Male	117	8.9	19.4	169	0.7	5.3 – 12.4	0.500
	Female	54	11.2	21.6			5.3 – 17.1	
Theatre name	Orthopaedic	117	10.0	14.4	169	-0.4	7.4 – 12.6	0.700
	ENT	54	8.8	28.9			0.9 – 16.7	
Type of surgery	Major	161	9.7	20.6	169	-0.1	6.5 – 12.9	0.900
	Minor	10	8.9	6.5			4.3 – 13.5	
Surgeon's qualification	Consultants	99	8.4	20.6	169	0.9	4.3 – 12.5	0.300
	Consultants & Registrars	72	11.3	19.3			6.8 – 15.8	

Differences in mean time GA is started and surgery start time

This was determined based on the difference in time between GA start time and start time of surgery. The findings reveal significant association between age group, surgical theatre and GA. Children aged 14 years and below took a significantly short mean GA induction and start time (22.4 minutes) than adults (31.3 minutes) (t = *-2.9*; df = 169; P = < 0.005). Similarly, GA induction and start time was shorter for patients who went for operations in ENT (20.7 minutes) in contrast with those in Orthopedic Theatre (31.8 minutes) (t = *-3.6*; df = 169; P = < 0.0005). There was no significant association between gender, classification of surgery, category of surgeon and GA induction and start time as shown in Table 10. Some of the reasons why there was delay in time GA was started and surgery start time in ENT Theatre were delay fixing IV line (2 cases). In Orthopaedic Theatre, the delays were caused by prewash (3 cases), lack of drill (3 cases), faulty C-Arm machine (2 cases), fixing IV line (1 case) and lack of sterile pack (1 case).

Table 10: Differences in mean time GA is started and surgery start time

Variables	Category	N	Mean	SD	df	t-test	95% CI	P value
Age group	Adult	113	31.3	20.7	169	-2.9	27.4 – 35.2	0.005
	Child	58	22.4	15.6			18.3 – 26.5	
Gender	Male	117	28.6	19.7	169	-0.3	25.0 – 32.2	0.800

	Female	54	27.6	19.4			22.3 – 32.9	
Surgical Theatre	Orthopaedic	117	31.8	20.6	169	-3.6	28.0 – 35.6	0.0005
	ENT	54	20.7	14.6			16.7 – 24.7	
classification of surgery	Major	161	28.3	19.8	169	-0.1	25.3 – 31.4	0.900
	Minor	10	27.7	16.2			16.1 – 39.3	
Category of Surgeon	Consultants	99	27.8	19.6	169	0.4	23.9 – 31.7	0.700
	Consultants & Registrars	72	29.0	19.5			24.4 – 33.5	

Discussion

The mean start time for the first surgical cases in elective orthopedic and ENT surgeries at MTRH, Eldoret

A comparison between mean start time for the first surgical cases in elective Orthopedic and ENT surgeries was done. Recommended start time for the operations is supposed to be 8.30 am. Deviations from this start time was calculated using 8.30 am as reference point and differences from the reference time and actual start time calculated and the means derived from the differences. Significant results were obtained when comparing delay in start time for the first surgical patient operated in Orthopedic and ENT theatres. Orthopedic Theatre was more likely to start conducting first operation earlier posting a mean on 64.5 minutes as opposed to ENT that start later with a mean of 102.5 (t=2.5; df=33; P = 0.02). Delay in start time for the first surgical patient in orthopedic theatre was attributed to two cases of surgeons reporting late. Starting of the first procedure scheduled for the day on time plays a crucial role in setting the tone for how an operating room (OR) functions. Inability to do so often affects the overall mood and support for performing all the cases in the room efficiently (Overdyk, Harvey, Fisherman & Shippey, 2014). The operating room is an expensive entity to management. Starting on time can also increase the capacity of a hospital to undertake more elective surgery. Furthermore, improvements in on-time starts are associated with increases in productivity and reductions in theatre list lengths and over-run times (Lacy, Paulman, Reuter, & Lovejoy 2012).

The association between socio-demographic and hospital factors and operating room time utilization in elective orthopedic and ENT surgeries at MTRH, Eldoret

Study findings showed a significant relationship between age group and delay in first surgery start time. Adults aged 14 years and above had a higher mean of 99.2 minutes compared with children aged less than 14 years with a mean of 63 minutes (t=2.5; df=33; P = 0.02). This implies that there was delay of 99.2 minutes with regard to start time for first surgical adult patients in contrast to children's 63 minutes. One of the studies reported similar finding where a patient's odds of experiencing late in-room placement increased with age was attributed to increased patient preparation complexity (Callie, Danielle, Killey & Scott, 2016).

Further examination on factors associated with delays in theatre operations during patient's journey to theatre were assessed. Results show that of the five independent variables, namely: age group, gender, surgical theatre, classification of surgery and surgeon's category, none had any significant association with delay in time though where such delays were reported, the main reason was lack of transport for patients. According to a study on the cost of trauma operating theatre inefficiency, difficulties with transport was a common problem causing a lot of delays (Ang *et al*., 2016).

Results show that the mean time taken from the time a patient is sent for and the time the nurse and porter wheel patient, scheduled for major surgeries was significantly lower (19.2 minutes) compared with those scheduled for minor surgery who took much longer with a mean of 43.8 minutes (*t=3.4*; df=109; P = 0.001). Poor patient preparation was the main reason for delay in wheeling the patient to theatre from the ward. Possible causes of delay for the first patient include, surgeons and anesthetist coming late, poor patient preparation, equipment failure and delays in surgical setup by nurses (Kirengo *et al.* (2015).

The mean difference between the time patient was sent for and arrival time in the receiving area was assessed and there was significant association between classification of surgery and delay in arrival in receiving area. Patients going for major surgeries spent significantly less mean time (29.4 minutes) in contrast to those going for minor surgeries with a mean of 51 minutes (*t=2.6*; df=108; P = 0.01). Preparation for major surgeries are more elaborate compared with that of minor surgeries. Special preference is therefore given to patients booked for major surgeries because of complex preparation secondary to complex surgery and patients may even be asked to arrive earlier as anesthetic part may take longer (Kgaugeto, 2013) and this is also seen in the time taken to wheel the former to theatre. Poor patient preparation was the main reason for delay wheeling the patient to theatre from the ward.

To determine differences in mean time patient was received in receiving area and time patient entered OR was assessed based on difference in arrival at the receiving area and time patient entered the or room. It has been shown that there is a significant association between age group, surgical theatre and category of the surgeon. The relationship between age group and delay in entering OR from receiving area was highly significant with a mean time of 90.8 minutes for adults aged 14 and above years and children aged 13 years and less with a mean time of 154.6 minutes (*t=4.9*; df=168; P = <0.0001). The reason is that children are the majority in ENT surgeries and are mostly done by senior clinicians who normally arrive late as stated by research findings. Patients being operated in

Orthopedic Theatre also took significantly shorter mean time of 96.7 minutes unlike those in ENT Theatre who took 146.7 minutes ($t=3.6$; df=168; P = 0.0004). Patients who were to be operated on by consultants/registrars equally took a significantly shorter mean time of 96.6 minutes as opposed to those who were to be operated by consultants with a mean time of 124 minutes ($t=-2.1$; df=168; P = 0.04). Notably, gender and classification of surgery had no significant bearing on delay in being received in OR room from receiving area.

In ENT Theatre, there were three cases where surgeons reported late causing delay in time patients entered receiving area and entering OR. The same was the case with Orthopedic Theatre where 3 surgeons reported late. The difference in time between time patient entered in OR and time GA was started was examined and the mean calculated. Results show that children aged less than 14 years took a significantly shorter mean time of 8.7 minutes compared with adult who took a mean of 10.1 minutes in terms of delay in starting GA upon arrival in OR ($t=-0.42$; df=169; P = <0.0001). Burrows *et al.* (2016) carried out a study on patients and procedural factors that affect anaesthetized non-operative time in spine surgery. The findings showed that patients who were > 65 years were significantly associated with increased non-operative time (Age > 65years: 103.2 minutes, Age < 65years: 97.2 minutes, mean difference of 6 minutes, p < 0.01).

With regard to the mean difference in time between GA start time and start time of surgery, the findings reveal a significant association between age group, surgical theatre and GA start time and start of surgery. Children aged 14 years and below took a significantly short mean GA induction and start time (22.4 minutes) than adults (31.3 minutes) ($t=-2.9$; df=169; P = <0.005). Similarly, GA induction and start time was shorter for patients who went for operations in ENT (20.7 minutes) in contrast with those in Orthopaedic Theatre (31.8 minutes) ($t=-3.6$; df = 169; P = < 0.0005).

Conclusion

There was a significant difference in mean start time for the first surgical cases in elective Orthopedic and ENT surgeries at MTRH. Orthopedic Theatre started its operations earlier than the ENT Theatre. This implies that the hypothesis stating that there is no significant mean difference in start time for the first surgical cases between elective orthopedics and ENT surgeries at MTRH is rejected and the conclusion is that there is significant difference in the start time for the first surgical cases between elective orthopedics and ENT surgeries.

Age group and start time for GA and start time for surgery significantly influenced operating room utilization. This implies that the hypothesis stating that there is no association between socio-demographic factors and delay in elective orthopedics and ENT surgeries at MTRH is rejected and the conclusion is that there is a significant association between socio-demographic factors and delay in elective orthopedics and ENT surgeries.

Study findings showed that the time utilization in elective orthopedic and ENT surgeries at MTRH was dependent on the surgical theatre and category of the surgeon. The mean time patient was received in receiving area and time patient entered OR showed that Patients being operated in Orthopedic Theatre took a significantly shorter mean time of 96.7 minutes compared to those in ENT Theatre (146.7 minutes).

The mean turnaround time for ENT Theatre was significantly lower 25 minutes than that of Orthopedic Theatre which had 49 minutes. Overall, the proportion of patients whose operations met the recommended turnaround mean time of 20 minutes or less (12%) were lower than those who took longer than 20 minutes (46.4%) suggesting a higher turnaround time than the normally recommended one.

Acknowledgement

I am greatly indebted to my supervisors, Prof. J. A. Oloo and Dr. G. Nguka, for their guidance throughout the writing of this thesis. I would also like to express my gratitude to MTRH administration for allowing me undertake this research in the hospital.

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