COLLEGE OF HEALTH SCIENCES

DEPARTMENT OF ANESTHESIA

MAGNITUDE AND ASSOCIATED FACTORS OF DELAYED FIRST CASE STARTS OF ELECTIVE SURGERIES AT TIKUR ANBESA SPECIALIZED HOSPITAL, ADDIS ABABA, ETHIOPIA, 2022/23: A HOSPITAL-BASED CROSS-SECTIONAL STUDY

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Magnitude and Associated Factors of Delayed First Case Starts of Elective Surgeries in Tikur Anbesa Specialized Hospital at Addis Ababa, Ethiopia, 2022/23: A Hospital-Based Cross-Sectional Study

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Approval sheet

I hereby certify that I have read and evaluated this thesis entitled "Magnitude and associated factors of the delayed first-case start of elective surgeries at Tikur Anbesa Specialized Hospital, Addis Ababa, Ethiopia, in 2022/23: A Hospital-Based Cross-Sectional Study" prepared under my guidance by Denekew Azene Amogne. I recommend that it is submitted as fulfilling the thesis requirement.

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Acronyms and Abbreviations

AOR	Adjusted odds ratio
ASA	American Society of Anesthesiologists
CI	Confidence interval
COR	Crude odds ratio
CV-line	Central venous line
ENT	Ear, Nose, and Throat
ETT	Endotracheal tube
FCOTS	The first case on-time start
GA	General Anesthesia
GIT	Gastrointestinal tract
ICU	Intensive care unit
IRB	Institutional Review Board
IV-line	Intravenous line
OPD	Outpatient department
OR	Operation room
OT	Operation theatre
RA	Regional anesthesia
SaLTS	Saving Lives Through Safe Surgery
TASH	Tikur Anbesa Specialized Hospital
USA	United States of America
WHO	World Health Organization

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Abstract

Background: Delayed first-case start in elective surgeries is a frequent occurrence in the operation theatre compared to the official start time. It has a major effect on a healthcare system with a magnitude of 24.8% to 99.3% contributed by a wide range of factors. Identifying the reasons for the delay indicates how to give solutions for delayed first-case surgeries.

Objective: To assess the magnitude and associated factors of delayed first-case start in elective surgeries at Tikur Anbesa Specialized Hospital, Addis Ababa, Ethiopia, 2022/23

Method: A hospital-based observational study was conducted on 421 first-cases of elective surgeries in Tikur Anbesa Specialized Hospital (TASH), Addis Ababa, Ethiopia, from January 9/2023 to April 28/2023. Using a systematic sampling technique, data were collected with a structured questionnaire. Each data collection was started at the patient reception area in the morning and ended up in the operation room after the skin incision. In data analysis, bivariate logistic regression analysis was done first and factors with $P < 0.20$ were selected for multivariable analysis. By multivariable logistic regression analysis, predictor variables with $P < 0.05$ in 95% confidence interval (CI) were selected as significant variables.

Results: The magnitude of the delayed first-case start in elective surgeries was 56.5% with a mean time delay of 32.62 minutes. Following multivariate logistic regression, factors such as lack of anesthesia/adjuvant drugs [AOR=2.648(1.137-6.165), P=0.024], late anesthesia induction [AOR=19.648(10.070 -38.337), P<0.001], surgeons' (fellows and residents) late arrival to the operation theatre [AOR=2.372(1.094-5.142), P=0.029], surgical positions other than supine [AOR=2.471(1.229 -4.969), P=0.011] and type of surgery were predictors of delayed first case start in elective surgeries.

Conclusion and recommendation: This study shows that starting operations for first cases was delayed among the majority of patients. Therefore, it is recommended to develop a first-case on-time start (FCOTS)initiative and improvement program to reduce first-case start delay of elective surgeries.

Keywords: magnitude, factors, delay, first case start/skin incision, operating room, TASH

CHAPTER ONE: INTRODUCTION

1.1 Background

First case on-time start (FCOSTS) of surgical procedures is an important operation room metric to provide timely and efficient surgical care. It is essential to improve operation room utilization. It is also one of the performance indicators for the efficiency of the operation room (OR). FCOTS involves many interdependent disciplines the patient, surgeon, anesthetist, and OR nurses (1).

The delayed start time of surgical procedures is defined based on the context in which it is applied. The first definition is starting surgical procedures later than 8.00 am for the first case(2). Other scholars defined the first case delay as the start time of the operations after 8.30 am(3,4). The second definition is the first case placement in the operation room one minute or more after the scheduled surgery time (5,6). Based on a "knife on skin" protocol for the first elective case, the third and common definition of the delayed first start in elective procedures is the start time of the skin incision one minute or more after the official start time(7,8).

Delays of surgical procedures are frequently occurred in the perioperative time and have a major effect on patient flow, resource utilization, and working environment, and have an impact on the rest of the daily activities, delaying future cases, reducing efficiency, and raising expenses(1). Studies also observed that delay in the operating theatre is a sign of an imperfect system(9).

Several factors come into play in determining the timing of an elective surgical procedure. Few studies identified various factors contributing to the first-case delay. Those factors are patient-related, OR team-related, and hospital-related factors which included a lack of proper planning, deficiencies in teamwork, communication gap, and limited availability of trained supporting staff. Their incidences ranged from 7% to 78.7% in contributing to a delay(2,8,10–14). Moreover, the OR team must complete all preoperative assessments and prepare appropriate equipment before the start time of elective surgical procedures of the day (15) because OR disorganization, and equipment failure can also lead to significant financial consequences and it can be a significant source of frustration for patients and operation room team (16). Usually, the delayed first-case start of surgeries is the insufficient performance of the operation theatre in its daily activities(17).

1.2 Statement of the problem

Delayed first-case start in elective surgeries is a worldwide challenge in the care of surgical patients. In developed countries, the magnitude of first-case start delay has a magnitude of 39.2% to 88%(10,12,14,18,19). In some African countries, the magnitude of first-case start delay of elective surgeries has a range of 24.8% to 99.3%(8,20). Even though there are no adequate studies done in Ethiopia, a single study done on first case delay of elective surgeries showed that the magnitude is 91.5% (21)

Delayed operating room start-time for surgical procedures disrupts surgical care services at various healthcare institutions(10,12,14,17,22). It affects the patient flow and OR utilization which costs organizations hundreds of dollars per given period (23). It also has a sequential effect on subsequent cases and reduces effectiveness throughout the day, and is associated with a rate of cancellation(9,24). It decreases staff and patient satisfaction(25). It increases hospital stay and the risk of acquired infection, morbidity, and mortality(26). It causes surgical and anesthesia errors in later cases due to exhaustion(27,28).

Numerous medical facilities implemented "first case on time start" measures to make improvements, but the issue is still widespread and unresolved(15,16,19,21,29,30). Based on situational analysis of surgical logbook waiting lists of patients at Tikur Anbesa Specialized Hospital (TASH), about 2, 074 patients were waiting for surgical treatment. Moreover, compared to the official start time of the hospital, delayed first-case start in elective surgeries in the operation theatre was a daily phenomenon for unspecified reasons. The magnitude and associated factors responsible for this delay were not well known and identified in TASH. Therefore, it is important to conduct a study on the delayed first-case start in elective surgeries to determine the magnitude and identify the responsible factors for delayed first-case surgical procedures.

1.3 Significance of the study

There are studies of a similar nature conducted in developed nations like Germany, the United States, and India(10,14,17). In health institutions such as TASH the ratio of clients to health professionals, the level of technology employed, the care providers' tendency for punctuality, the availability of drugs and equipment, the population, and the economic status of the nations affect the healthcare system.

This study helps the institution to improve surgical care services; increase operation room turnover; and decrease case cancellations due to shortage of time. It also helps to increase patient satisfaction; to decrease hospital stays; to decrease the prevalence of acquired infections, morbidity, and mortality; to improve patient outcomes; and decrease frustration for patients and the OR team due to prolonged waiting. It also helps health professionals to decrease surgical and anesthetic errors due to exhaustion, and to expand knowledge on the magnitude and associated factors of first-case delay for surgery. It helps future researchers to compare the magnitude and associated factors in a similar study area; to promote health research and education; and to contribute a piece of information for the scientific community.

Therefore, this study enables patients, healthcare providers, policymakers, and hospital administrators to recognize the magnitude and associated factors of first-case start delay among elective surgeries. It is also used to reduce the problem and help to improve quality care increment. This observational study identified the magnitude and associated factors of the first-case start delay of elective surgeries on the intended days of the schedules in TASH. It showed the gaps among elective first case starts in the operating room and elaborated on the problem for hospital administrative bodies and the Federal Ministry of Health at large.

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CHAPTER TWO: LITERATURE REVIEW

Delay to start surgical procedures on time in the operating room is a common challenge in different countries(1,10,17). Several factors come into play in determining the timing of an elective surgical procedure(6,14,31). The first case delay is multifactorial. It can be affected by anesthesia, surgery, facility, health personnel, and patient factors(8,13,24,31,32).

2.1 The magnitude of the first case delay

Martin Schuster and Marco Pezzella assessed 21, 357 surgeries in the first position in a prospective observational study and they carried out in 2013 in 22 German hospitals, which examined more than 20,000 cases. In over 70% of cases involving general surgery, trauma, or orthopedic surgery, the incision was delayed. Between 20% and 40% of the time, there were delays longer than 10 minutes(10). In a separate prospective study conducted over five days in March 2010 in a UK District General Hospital for recording start-time delays and total daily delays during 227 multiple-specialty cases, S. Ciechanowicz and N. Wilson found that 78% of cases began on time, or within 15 minutes of the scheduled time. Delays occurred in the remaining 22% of situations(13). Another multicenter prospective study conducted in 2020 at 36 German and Swiss hospitals with a total of 3,628 initial cases for two weeks revealed that 50.8% of the first cases of the day were delayed by more than 5 min from the moment of skin incision. Between 40.0% and 66.8% of surgical procedures had delayed incision times of greater than five minutes(12).

A similar study done by R. Jonnalagadda at Queen Elizabeth Hospital, Barbados, revealed that only 7% of surgical procedures started on time. The rest procedures (93%) were delayed to start(11). Blake Saul and Elise Ketelaar performed a retrospective analysis on orthopedic cases as the first case on time start at a busy level II community hospital in 2019. Throughout the study period, 39.2% of all first cases were exposed to be delayed(14).

A first-case delay is not only during start time. It may also prolong beyond the estimated time. A prospective study conducted by Chike John Okeke from January 2016 to March 2017 on all consecutive elective cases at a referral hospital in Southeast Nigeria revealed that 99.3% of all surgical procedures were delayed, with a mean delay time of 151 minutes during the study period. First cases accounted for around half of the delay (47.5%), with a larger delay period (198.9 min) than other cases(8). In a study also ended in Germany, at Universitatsmedizin Greifswald, to

analyze the timeliness of operating room cases, 86% of the daily schedules were first cases. From these first case schedules, 92% of them were delayed with a deviation of incision time of more than 10 min(22). Thus, surgical delay occurred in deathcare institutions even though it has a different magnitude across the world.

2.2 Factors associated with first-case start delay of surgery

The study done by Chike John Okeke in a referral hospital in Southeast Nigeria from January 2016 to March 2017 identified patient-related, surgeon-related, and hospital-related factors (31.3%, 28.5%, and 26.2% respectively) as common causes of delay for total scheduled cases. Patient-related factors accounted for 43.2% of first-case delays(8). Likewise, in a prospective study done on 1, 160 general surgery patients in Soroti Regional Referral Hospital by Savannah Starr and Woon Cho Kim from January 2017 to February 2020 in which 263 (22.3%) patients experienced a delay of care, lacking operating theater space (73.0%), shortage of equipment (19.8%) and personnel (14.1%) were main contributors to delay(33). Jemimah Kimeu in Kenya conducted a cross-sectional study among three private health facilities that identified staff and management factors ($P<.007$, $P< .000$ respectively) as significant factors for delays of elective surgical cases(31).

Martin Schuster and Marco Pezzella reported that anesthesia preparation and incision time were responsible factors for surgical delay(10). C. Joos and S. Bertheau also underlined that prolonged induction of anesthesia, delayed appearance of the surgeon and prolonged preparation for surgery were the main reasons(12). A retrospective study by Blake Saul and Elise Ketelaar on orthopedic cases identified surgeon practices, preoperative processes, and room-related causes as major contributors to delay (56.5%, 18.3%, and 13.0%) respectively(14). A review of the evaluation of the reasons for cancellations and delays of surgical procedures in developing country that reported by R. Jonnalagadda identified delayed transporting of patients to the operating theatre (17%) as the most common cause(11). According to Babita Gupta’s perspectives, a lack of proper planning, deficiencies in teamwork, communication gap, and limited availability of trained supporting staff were identified as causative factors in start time operative delays(7). During their study on the incidence of delays to operating theatre lists and reasons, S. Ciechanowicz and N. Wilson recognized that hospital-wide factors were the most common reason for the delays (72%). Of hospital factors.48% were due to ward bed issues; 15% were due to doctors' factors; and 13%

were inadequate pre-operative assessment and equipment failure (13). Hence, factors associated with the delayed first-case start of elective surgeries are multidirectional. They can be emanated from a patient, health personnel, facility, and type of treatment which has to be delivered.

2.3 Conceptual framework

Based on reports from different pieces of literature, first-case start delay in surgery (FCSD) was affected by the patient, surgery, anesthesia, hospital, and OR staff-associated factors. These include sociodemographic, ASA physical status, types and positions of surgery, facility supplies, anesthesia techniques, and induction and staff punctuality(4,6,34).

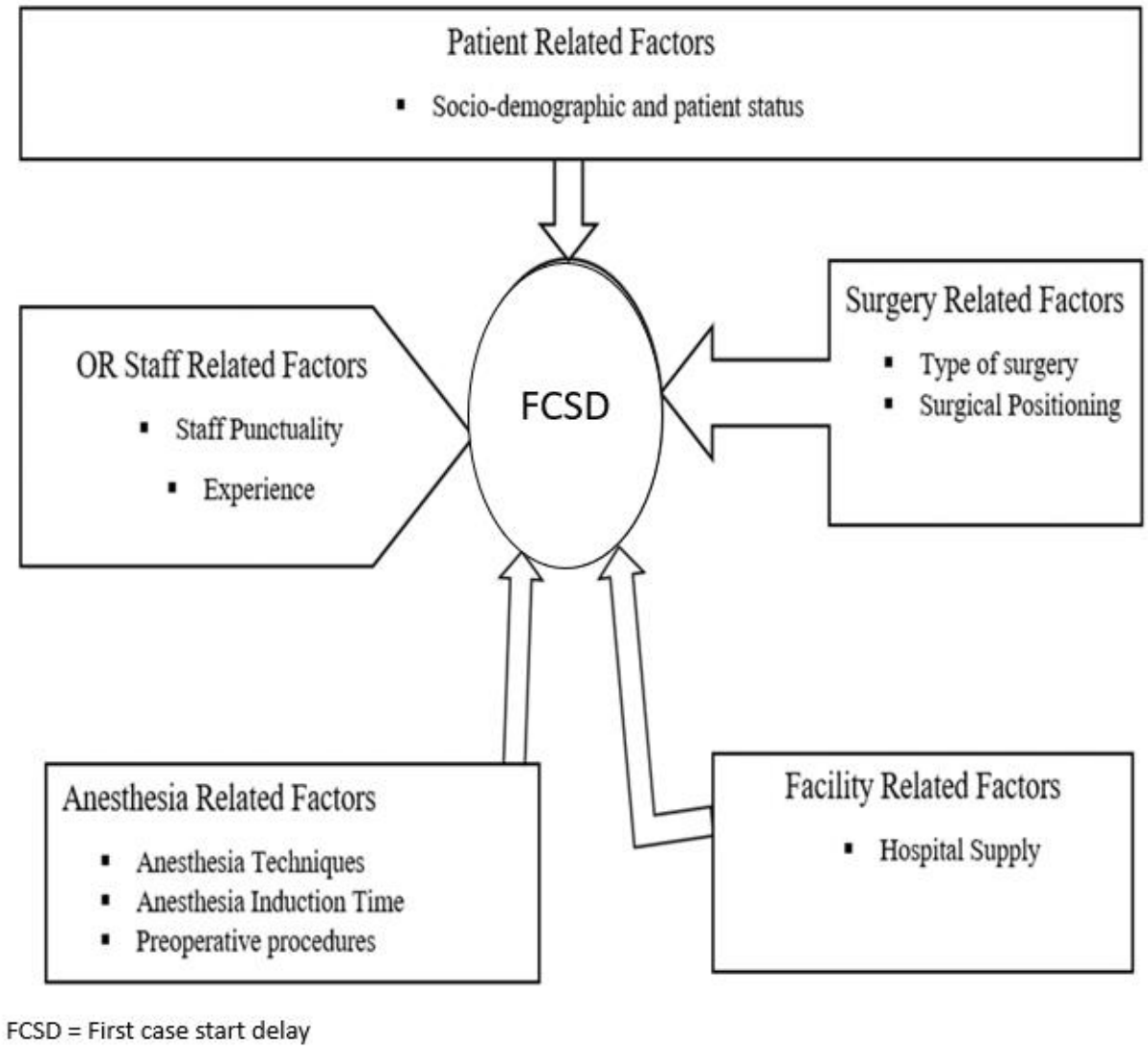


Figure 1:Conceptual framework on the assessment of first case start delay and associated factors of surgical procedures at TASH, Addis Ababa, Ethiopia, 2022/23 which was adapted from Yamuragiye Assumpta's literature (32).

CHAPTER THREE: OBJECTIVE

3.1 General Objective

- To assess the magnitude and associated factors of delayed first-case start in elective surgeries at TASH, Addis Ababa, Ethiopia, 2022/23

3.2 Specific Objectives

To determine the magnitude of delayed first-case start in elective surgeries at TASH, Addis Ababa, Ethiopia, 2022/23

- To identify associated factors of delayed first-case start in elective surgeries at TASH, Addis Ababa, Ethiopia, 2022/23

CHAPTER FOUR: METHODOLOGY

4.1 Study setting and period

This study was conducted at Tikur Anbessa Specialized Hospital from January 9/2023 to April 28/2023. TASH is located in Addis Ababa the capital city of Ethiopia. TASH is the largest referral hospital in Ethiopia with 700 beds. It has 13 operating rooms for elective surgeries and 4 operating rooms for emergency surgeries. It is also the main teaching hospital under Addis Ababa University for both undergraduate and postgraduate programs of many disciplines including subspecialties It was intentionally selected for this study assuming that it is a tertiary hospital that gives surgical treatment for twelve specialties.

4.2 Study design

A hospital-based cross-sectional study design

4.3 Population

4.3.1 Source population

All elective surgical patients who underwent surgical treatment at TASH

4.3.2 Study population

All elective surgical patients who underwent surgical treatment as first cases in the study period at TASH.

4.4 Eligible criteria

4.4.1 Inclusion criteria

All elective first cases who underwent surgical treatment and didn't have a previous elective surgical history in the study period in TASH.

All elective non-first cases who manipulated to be first cases before the day of surgery or early in the morning and didn't have previous elective surgical stories in the study period at TASH.

4.4.2 Exclusion criteria

All elective first cases who canceled from daily schedule lists

All elective first cases who manipulated to be second or more in daily schedule lists

All elective first cases who refused consent for study

4.5 Study variables

4.5.1 Dependent variable

Delayed first-case start in elective surgeries

4.5.2 Independent variables

Table 1:List of independent variables

Patient-related factors	Residency
	Consent process
	Patient's economic status
	Admission status
	ASA physical status
	X-matched blood requirement
	ICU beds requirement
Anesthesia-related factors	Preoperative procedures (IV-line, CV-line, or A-line)
	Anesthesia techniques
	Anesthesia preparation
	Anesthesia induction time
Facility-related factors	Anesthesia drugs
	Resuscitation fluids
	Oxygen availability
	Electricity consistency
	Operating room light

	Water supply
	Cautery machine
	Suction machine
	Anesthesia machine
	Anesthesia monitor
Staff-related factors	Consultant surgeons' punctuality
	Residents/fellows' punctuality
	Anesthesiologists' punctuality
	Anesthetists' punctuality
	OR nurses' punctuality
Surgery-related factors	Type of surgery
	Position of the procedure

4.6 Sample size and sampling method

4.6.1 Sample size determination

Sample size(n) was calculated using a single population proportion formula with a 95% confidence interval or a 5% margin of error. In a study conducted by Okeke et.al in 2016/2017 on a delay of surgery start time at a Nigerian Teaching Hospital, delayed first cases start accounted for 47.5% of all delayed cases(8). By taking this magnitude of first-case start delay of surgical procedures, the sample size(n) was calculated as follows:

$$n = \frac{(Z\,\alpha/2)^{2}\,P(1-p)}{d^{2}}$$

Za/2 = 1.96 (for a 5% level of significance)

P = proportion of event of interest

d = Precision (or margin of error)

$$n = \frac{(Z\,\alpha/2)^2\, P(1-p)}{d^2}$$

$$n = \frac{(1.96)^2\, 0.475(0.525)}{0.05^2} \approx 384$$

n = 384 participants

To ensure a minimum of 384 patients were included, an additional 38 first cases (10 % non-response rate) were enrolled to account for potential protocol violations and missing data. Total participants = **422** patients

4.6.2 Sampling method

A systematic sampling technique was applied to select the study participants based on operation room orders. The operation rooms were assigned as room one, room two, room three up to room thirteen starting from the first ENT room to the last orthopedic room in the hospital (Table 1).

Table 2: Operation rooms order and location for elective patients at TASH in 2023

Operation Room order for data collection	Operation Room location in the Hospital
Room 1	ENT table in major OR
Room 2	A cardiothoracic table in major OR
Room 3	A vascular table in major OR
Room 4	Neurosurgery table in major OR
Room 5	A pediatric table in major OR
Room 6	GIT table in major OR
Room 7	Gynecology table in major OR
Room 8	Open Urology table in major OR
Room 9	Endourology table in major OR
Room 10	Elective Obstetric table on floor 6

Room 11	Orthopedic table 1 at orthopedics building
Room 12	Orthopedic table 2 at orthopedics building
Room 13	Orthopedic table 4 at orthopedics building
Total	13 rooms

To recruit participants in the survey for four months, we considered the sequential schedule of first cases who underwent surgery in each operation room as a sampling frame. According to a six-month report of the hospital's registry, about 1,386 cases were operated as first cases in 131 working days. From these cases, 924 first cases were operated in four months (88 working days) in which about 231 first cases were operated per month. To apply a systematic sampling technique, the interval k, was calculated as $924/422 \approx 2$(Table 2).

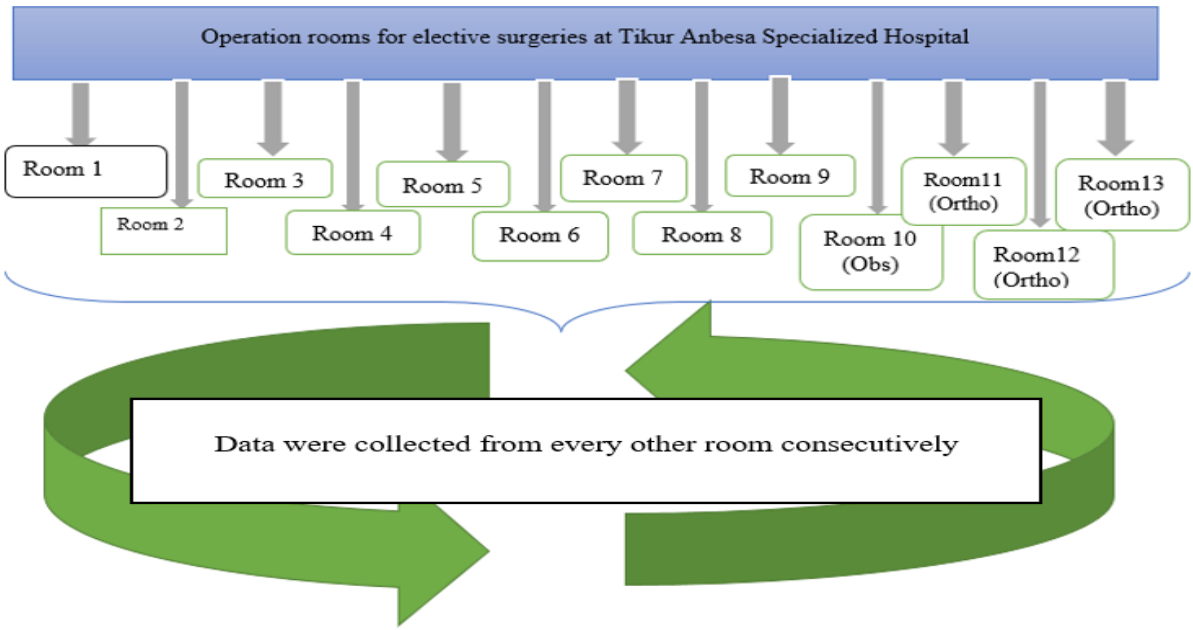
Table 3:A Six-month registry report of first cases and working days from logbooks at TASH from July-December, 2022

Surgical Center	TASH
Total working days per six months	131
Total First cases per six moths	1,386
Total working days per four months*	88
Total First Cases per four months*	924
Total First Cases per Month*	231
Total First Cases per working day*	11
Required Sample (without non-response rate)	422
Calculated interval(K)	2

* Average

The starting room on the first day of data collection was selected by the lottery method between room one and room two. Room one (ENT room) was selected (Fig 2). Then, from all first cases of daily operations, data were taken from every 2nd first case following operating room order. In this similar data collection technique process, a data collector rotated every working day to collect data

from every other first case (Fig 2). Data collection was continued until April 28/2023 due to the sample size to be reached.



KEYS: Obs = obstetrics, Ortho = orthopedic

Figure 2: A road map for data collectors and sampling technique process at TASH in 2023.

4.7 Data collection tool and technique

A structured questionnaire was used to collect the required information. The questionnaire constituted of socio-demographic and patient factors, anesthesia factors, staff factors, surgery factors, and facility factors. Data collection was held from January 9/2023 to April 28/2023 at TASH, Addis Abeba, Ethiopia. Two senior BSc anesthetists and one anesthesiology resident were involved in the data collection process. Each data collection was started at the patient reception area around the operation theatre (OT) in the morning and ended up in the OT after the skin incision. Sociodemographic and preoperative variables were obtained from medical charts and interviews. For patients who fulfilled inclusion criteria, chart review and direct observation of skin incision/WHO surgical safety checklist records/anesthesia sheet records were used to collect the information. At the same time, data collectors checked data quality and completeness at the end of the data collection time.

4.8 Data quality assurance

Training and orientation about the objectives of the study, the relevance of the study, study tools, and the data collection process were provided for data collectors by the principal investigator. To assure the reliability of the data, questionnaires were pretested on 5% of the sample size before starting actual data collection in the same study area. At the time of data collection for the pretest, confidentiality was considered to prevent data cross-contamination. Based on the pretest, questions were revised and edited. Necessary modifications were made before actual data collection. For completeness and consistency of data, regular supervision and follow-up were done by the principal investigator.

4.9 Data analysis

Initially, the collected data were coded and entered into the Epi data version 3.1 software. Then, data were exported to Statistical Package for Social Sciences (SPSS) software version 26 for analysis. Recoding of some variables was done before starting data analysis. Binary logistic regression model assumptions were checked and descriptive statistics were applied to compute frequencies, percent, and mean. Bivariate logistic regression analysis was used to identify candidate variables. Each independent variable was analyzed with the dependent variable. Crud odds ratio (COR) with a 95% confidence interval (CI) and P-value were computed to differentiate candidate variables and strength of association. Factors having a p-value of less than 0.20 during bivariate logistic regression analysis were involved in the multivariate logistic regression analysis. Hosmer and Lemeshow goodness of fit test was checked and annexed. Multivariate logistic regression analysis was used to assess the relationship between an outcome variable and associated factors using enter method. Adjusted odds ratio (AOR) with 95% CI and P-value of less than 0.05 were used to identify the significant association.

4.10 Operational definition

- **Surgical schedule** - a document that provides a list of the number of different surgical procedures.
- **Elective surgery** - is a non-emergency surgery that is medically necessary, but can be delayed for at least 24 hours(35).
- **The first case** - the first elective case scheduled in the operation room for the day(23).

- **Official start time**- the time when the patient and all members of the surgical team are expected to be in OR and the skin incision starts. Medical institutions use their own "knife on skin" protocol for the first elective case on their official start time(7,8). Based on its protocol, the official start time for skin incision at TASH is 9:00 am. At TASH, OR doors open at 7:00 am; the patient enters the operation room at 8:00 am; anesthesia induction time at 8:30 am and skin incision at 9:00 am are set as benchmarks.
- **Late anesthesia induction**- induction of anesthesia one or more minutes later than 8:30 am
- **Operating room**: a place within a hospital where surgical procedures are performed in a sterile environment. It is also called operating theatre (OT).
- **On-time start** – skin incision time that occurs at or before the official start time
- **Skin incision time** – a time when a knife is on the skin/insertion of surgical or diagnostic instruments for elective cases.
- **Delayed start time** – Skin incision time later than 1 min, or more than the scheduled time(24).
- **Early in the morning** -a period before patient entry to the operation room at 8:00 am.

4.11 Ethical clearance

To conduct this study, ethical clearance and a letter of permission with IRB Ref. No Anes/27////2022/2023 was obtained from Addis Ababa University Ethical Review Committee and TASH administrative office. Informed written consent was secured from every study participant before the start of the interview. After telling the patient (family of the patient) about the objective of the study, the obtained data were used only for study purposes. Confidentiality was ensured.

4.12 Dissemination of the result

The result of this study will be presented to Addis Ababa University, College of Health Science. A copy of the study results will also be submitted to the anesthesia department. Further efforts will be made to publish the findings in a national or international peer-reviewed journal.

CHAPTER FIVE: RESULTS

Of 422 participant elective first cases, 421 participant cases(n) were involved in this study. One participant had incomplete information and was cleared from data analysis.

5.1 Socio-demographic and patient-related factors

Regarding ASA physical status, 139(33.0%) patients were ASA I, and 282(67.0%) were ASA II and above. Besides these, 92(21.9%) patients had ICU (intensive care unit) bed preservation, and 333(79.1%) patients had cross-matched blood preservation (Table 4).

Table 4:Patient and staff-related factors for first cases skin incision delay among elective surgical patients operated at TASH, Addis Ababa, Ethiopia, 2023(n=421)

Variables	Categories	Frequencies	Percent
Residence	Urban	271	64.4
	Rural	150	35.6
ASA physical status	ASA I	139	33.0
	ASA≥II	282	67.0
ICU bed indication/preservation before OR entry	Yes	92	21.9
	No	329	78.1
X-matched blood indication/preparation	Yes	333	79.1
	No	88	21.9
MSc anesthesia students/ residents' arrival (before 8:00 am)	Yes	415	98.6
	No	6	1.4
Anesthesia consultants' arrival (before 8:00 am)	Yes	344	81.7
	No	77	18.3
OR Nurses' arrival (before 7:30 am)	Yes	309	73.4
	No	112	26.6
Fellows/Residents' arrival (before 8:00 am)	Yes	329	78.1
	No	92	21.9
Consultant Surgeons' arrival (before 8:30 am)	Yes	295	70.1
	No	126	29.9

5.2 Staff-related factors

Anesthesia and surgery consultants arrived late for 77(18.3%) and 126(29.9%) first-scheduled patients respectively. Fellows/residents and MSc anesthesia students/residents also arrived late for 92(21.9%) and 6(1.4%) first cases respectively (Table 4).

5.3 Facility-related factors

Operation rooms were opened lately for 116(27.6%) patients and electricity interruption occurred in 48(11.4%) patients in the study period. In addition to these, there was a lack of anesthesia/adjuvant drugs in a supply room/pharmacy at the time of operation for 106 (25.2%) first scheduled patients (Table 5).

Table 5: Facility-related factors for first-cases-skin-incision delay among elective surgical patients operated at TASH, Addis Ababa, Ethiopia, 2023(n=421)

Variables	Categories	Frequency	Percent
Operation room opening at or before 7:00 am	Yes	305	72.4
	No	116	27.6
Adequate oxygen in a cylinder before patient entry	Yes	373	88.6
	No	48	11.4
All basic airway equipment available in OR	Yes	386	91.7
	No	35	8.3
Resuscitation fluids (NS & RL) availability in a supply room/pharmacy	Yes	388	92.2
	No	33	7.8
All common anesthesia drugs/adjuvants available in the supply room(pharmacy)	Yes	315	74.8
	No	106	25.2
Electricity interruption	Yes	48	11.4
	No	373	88.6

5.4 Anesthesia-related factors

General and regional anesthesia techniques were applied for 284(67.5%) and 116(27.5%) patients respectively. Anesthesia induction was late for 239 (56.8%) patients (Table 6).

Table 6: Anesthesia-related factors for first-cases-skin-incision delay among elective surgical patients operated at TASH, Addis Ababa, Ethiopia, 2023(n=421)

Variables	Categories	Frequencies	Percent
Preoperative anticipated difficult airway	Yes	87	20.7
	No	334	79.3
Anesthesia technique	General	284	67.5
	Regional	116	27.6
	Both	21	5.0%
Complete anesthesia preparation before 8:30 am	Yes	363	86.2
	No	58	13.8
Anesthesia induction at or before 8:30 am	Yes	182	43.2
	No	239	56.8
Secured A-line before skin incision	Yes	106	25.2
	No	315	74.8

Key: A-line = arterial line

5.5 Surgery-related factors

Of 421 participant patients, 295(70.1%) patients were operated on a supine position from twelve surgical specialties (Fig 3).

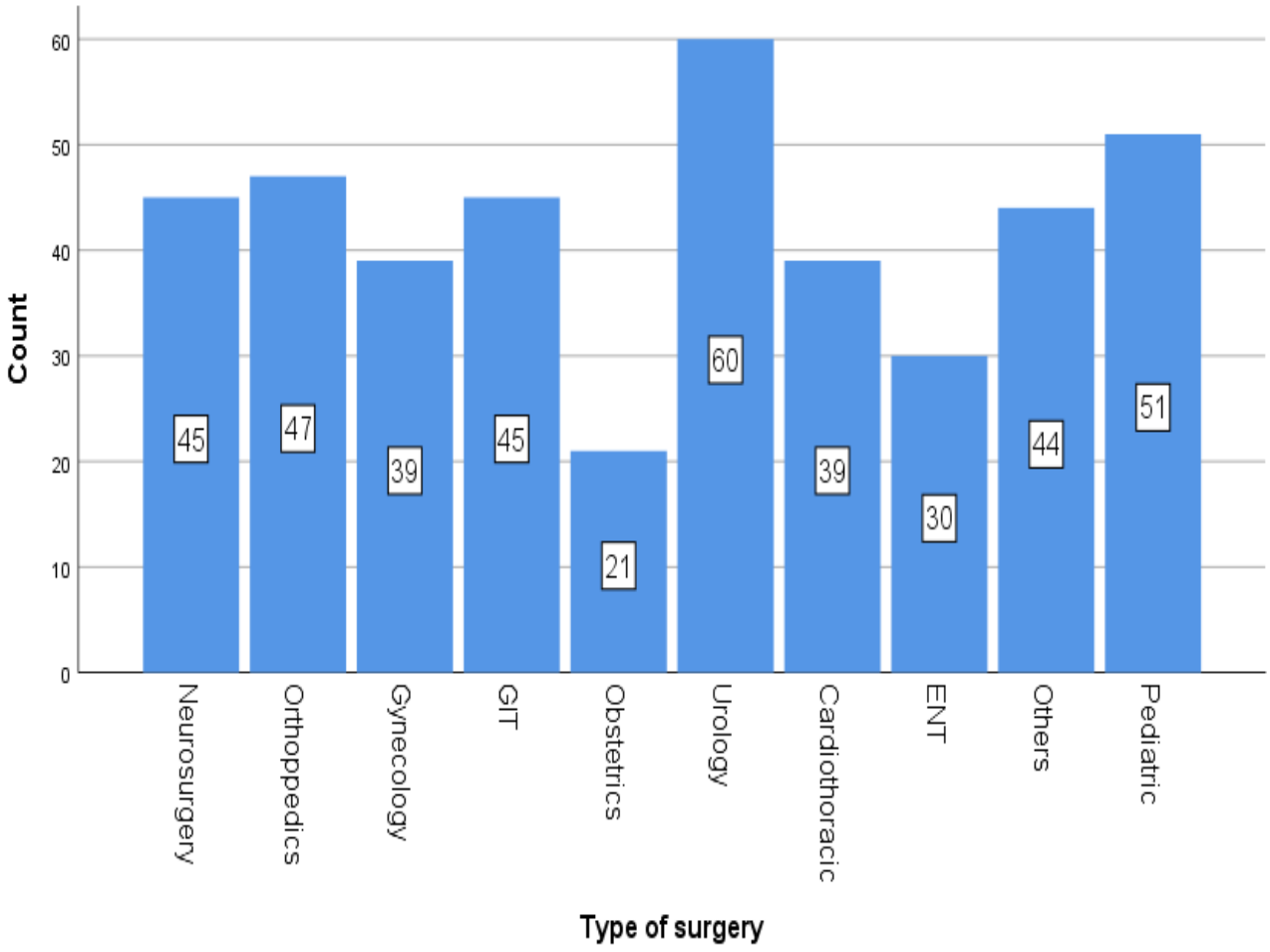


Figure 3: No. of participant cases from twelve surgical specialties at TASH in 2023.

5.6 Magnitude of first cases start (skin incision) delay

In this study, 238(56.5%) patients who were scheduled and operated on as first cases were delayed for on-time skin incisions with a mean time delay of 32.62 minutes (Fig 4).

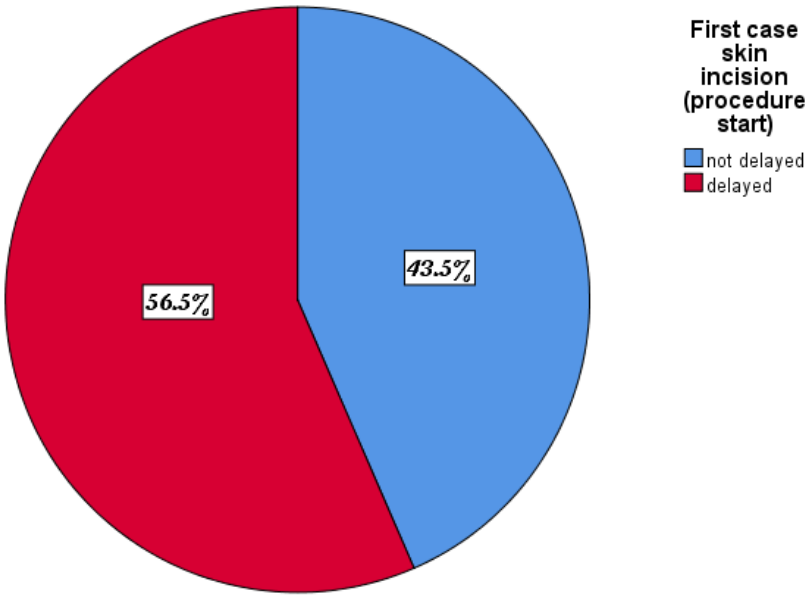


Figure 4:Magnitude of delayed first case skin incision at TASH in 2023.

5.7 Factors associated with delayed first case start/ skin incision

In this study, lack of anesthesia medications in the supply room/pharmacy, surgeon's (fellows/ residents) punctuality, induction of anesthesia, the surgical position of patients, and type of surgery were significantly associated with first-case skin incision delay (Table 7). The odds of first-case skin incision delay for patients who encountered scarce anesthesia drugs in the operation theatre supply room(pharmacy) was 2.648(1.137-6.165) times more likely than adequate supply time. Similarly, the odds of first-case skin incision delay due to surgeons'(fellows/residents) late arrival to the operating room was 2.372(1.094-5.142) times more likely than on-time arrival to the room. Also, the odds of first-case skin incision delay due to late anesthesia induction was 19.648(10.070-38.337) times more likely than on-time anesthesia induction (Table 7).

Table 7:Bivariate and multivariable logistic regression analysis to identify factors associated with first-case skin incision delay among elective surgical patients at TASH, Addis Ababa, Ethiopia in 2023(n= 421)

Variables	Categories	First-case-skin-incision		Bivariate-Analysis		Multivariate Analysis	
		Delayed	Undelayed	COR	P	AOR (95% CI)	P
ICU Indicated (preserved)	Yes	71	21	3.280	<0.001	1.727(0.730-4.086)	0.214
	No	167	162			1	
Common AW equipment	Yes	214	172			1	
	No	24	11	1.754	0.138	1.035(0.331-3.234)	0.952
Fluid (NS & LR) supply	Yes	173	65			1	
	No	152	31	1.842	0.013	0.786(0.326-1.897)	0.592
Anesthesia/adjuvant drugs availability	Yes	161	154			1	
	No	77	29	2.540	<0.001	2.648(1.137-6.165) *	0.024
Surgeons' arrival at/before 8:00 am	Yes	174	64			1	
	No	155	28	2.036	0.005	2.372(1.094-5.142) *	0.029
Patient entry at/before 8:00 am	Yes	59	82			1	
	No	179	101	2.463	<0.001	1.290(0.688-2.418)	0.427
Anticipated difficult AW	Yes	55	32	1.418	0.159	1.070(0.513-2.231)	0.856
	No	183	151			1	
Anesthesia preparation before 8:30 am	Yes	189	174			1	
	No	49	9	5.012	<0.001	0.449(0.166-1.209)	0.113
A-line before incision	Yes	73	33	2.011	0.003	1.797(0.811-3.980)	0.148
	No	165	150			1	

Anesthesia induction at/before 8:30 am	Yes	42	140			1	
	No	196	43	15.194	<0.001	19.648(10.070-38.337) *	<0.001
Anesthesia technique	General	157	127			1	
	Regional	65	51	1.031	0.891	1.111(0.481-2.566)	0.805
	Both	16	5	2.589	0.071	1.938(0.498-7.541)	0.340
Surgical position	Supine	156	139			1	
	Others	82	44	1.661	0.021	2.471(1.22-4.969) *	0.011
Type of surgery							
	Neuro	39	6	10.075	<0.001	12.017(2.830-51.037) *	0.001
	Ortho	37	10	5.735	<0.001	13.929(3.775-51.390) *	<0.001
	Gyne	18	21	1.329	0.509	1.135(0.354-3.642)	0.832
	GIT	19	26	1.133	0.765	2.620(0.787-8.726)	0.117
	Obs	11	10	1.705	0.307	0.940(0.188-4.697)	0.940
	Uro	21	39	0.835	0.647	1.169(0.387-3.531)	0.782
	Cardio	30	9	5.167	0.001	4.224(1.076-16.579) *	0.039
	ENT	9	21	0.664	0.405	1.603(0.424-6.066)	0.487
	Others	34	10	5.270	<0.001	9.393(2.569-34.345) *	0.001
	Pedi	20	31			1	

Keys: 1= indicates the reference group, * Significant association at p-value < 0.05, COR = crude odds ratio, AOR = adjusted odds ratio, CI = confidence interval, NS = normal saline, LR = lactated ringer's solution, AW=airway, Neuro= neurosurgical, Ortho= orthopedic, Gyne= gynecologic, Obs= obstetric, Uro= urologic, Cardio= cardiothoracic, Pedi= pediatric

CHAPTER SIX: DISCUSSION

The purpose of this observational study was to assess the magnitude and contributing factors of delayed first-case start/skin incisions among elective surgical patients. Patients who were scheduled for and underwent surgery first throughout the study period had assessed for their first case skin incision. It was determined what the magnitude was and what factors it was related to.

The result of this study showed that the magnitude of delayed first cases-skin incision was 56.5% with a mean start time delay of 32.62min, which is comparable with an observational study done at Metro Health Medical Center academic teaching institution in the USA in 2018(55%)(6). The similarity may be due to being a tertiary teaching institution like TASH approximately with the same surgical sub-specialties. The result of this study is also found approximately in line with a large study done on incidences of delayed surgical incision time among first scheduled surgical patients in 36 German and Swiss hospitals in 2019(50.8%)(12). Even though the large study was done in a developed country, the result was as high as the present study done in Ethiopia at TASH. The reason could be that the large study in Germany used a large sample size (3,628 first cases).

On the contrary, the magnitude of this result is high when compared to an improvement study(39.2%) by Saul B.et al (14). The rationale support might be that the study by Saul B.et al was an improvement study and the magnitude could be reduced after the intervention. The result of this study is also high when compared to another study done in Nigeria(47.5%)(8). The reason behind it might be setup differences between institutions because the study is institutional-based.

On the other hand, the magnitude of this study is low compared to another observational study that was done in Nigeria(89.8%)(2). Staff punctuality, the utilization of a bigger sample size (889 first cases), and preoperative patient assessment in the Nigerian institution could be the reasons for the difference. The outcome of this study is also less comparable to the outcome of a study done in the same study area, at TASH in 2021 (91.5%)(21). The cutoff point for skin incision delay (8:30 am), seasonal challenges for the COVID-19 test, the sampling method used for data collection(purposive), or seasonal shortage of blood in the blood bank may be the reasons for its high magnitude. However, in the present study, the cutoff point for skin incision delay was 9:00 am and a systematic random sampling method was applied. These may reduce the magnitude of the first-case start delay.

According to this study, lack of anesthetic/adjuvant medications in operation theatre supply room/pharmacy [AOR=2.648(1.137-6.165), P=0.024] increased the first case skin incision delay which is supported by a study done in Nigeria(2). The reason might be that the anesthetists or anesthesiologists wasted time by looking for drugs in other rooms; they might have been waiting for medications from private pharmacies outside the hospital; or they may discuss with their colleagues or consultant anesthetists/ anesthesiologists about using different drugs instead of planned drugs.

The finding of this study also showed that late anesthesia induction [AOR=19.648(10.070 - 38.337), P<0.001] extended the time taken to make a skin incision. In a similar study done in Germany, prolonged induction of anesthesia was marked as a determining factor for first-case start delay(12). The reasons for late induction of anesthesia could be anesthetic procedures/ practices, staff punctuality, a higher level of ASA physical status among surgical patients, or setting up more invasive lines.

Surgeons' (fellows and residents) late arrival to the operation room [AOR= 2.372(1.09-5.142), p= 0.029] also increased the first case skin incision delay by 37.2%. The proportion of surgeons who arrived late in this study is smaller compared to a study conducted in Nigeria (78.7%)(2). The delay may have been caused by the Nigerian surgeons' prolonged morning sessions and ward visits before entering the operating room, setup differences between institutions in Nigeria and Ethiopia, or the different cutoff points for delays based on institutional protocols.

In this study, operative positions other than supine [AOR=2.471(1.22-4.969)), P= 0.001] were also found to be significant factors in the first case of skin incision delay. When the patient was operated in positions other than supine, it took a longer time to finish surgical preparation. Therefore, operative positions other than supine prolong the first case skin incision delay by 47.1%.

Furthermore, types of surgery such as neurosurgery [AOR=12.017(2.830-51.037), P=0.001], orthopedic surgery [AOR=13.929(3.775-51.390), P<0.001], Cardiothoracic surgery [AOR=4.224(1.076-16.579), P=0.039], or other (maxillofacial, endocrine, and vascular) surgeries [AOR=9.393(2.569-34.345), P<0.001] also increased the first-case skin incision delay compared to pediatric surgery. Many possible explanations might be listed in the present study. In neurosurgery, lengthy preparation for applying pins, fine-tuning of equipment for microscopic procedures, or the need for more invasive lines may be the reasons for the delay. In orthopedic

surgery, patients' restricted movement due to bone fractures, the need for bedside preoperative x-rays on the operating tables, a malfunctioning lift at the orthopedics building, or lack of stretchers or wheelchairs on the floor may be the reasons for the first-case skin incision delay. The effect of orthopedic surgery on first-case skin incisions is highly comparable with a study done in Germany(70%)(10). The first-case skin incision delay in Cardiothoracic surgery might also be due to preferring regional anesthetic procedures (epidural, paravertebral, and erector spine plane blocks), intubating with a double lumen tube (DLT), anesthesia practices, or more invasive lines. Similar to this, hemodynamic instability in endocrine procedures, high risk of bleeding in vascular procedures, and shared airway in maxillofacial operations may be the possible reasons for the delay.

In a similar study done at TASH in 2021, lack of blood (P=0.008) and ICU beds (P=0.002) were identified as predictors of the delayed first-case start of surgery(21) but in the present study, they are not significantly associated with delay. The reasons might be that seasonal shortages of blood and ICU beds might happen during the previous study period. It might be due to the sampling method that was preferred(purposive). However, in the present study period, patients who were indicated for blood or ICU admission were not scheduled as well as postponed for surgery if they didn’t have preserved blood or ICU beds.

CHAPTER SEVEN: STRENGTHS AND LIMITATIONS OF THE STUDY

7.1 Strength

The study participants were representative. The study is an observational study and used primary data sources. Thus, it can minimize the discrepancy in data management processes. The finding is also generalizable for TASH. The result of the study provides valuable data to improve operation room efficiency and reduce the impact of first-case delay on consecutive schedules.

7.2 Limitation

- The study didn't use a national guideline to determine the cutoff point for skin incision delay and put its definition because there is no one consistent national guideline for health facilities in Ethiopia (36).
- Data collectors were only anesthetists and anesthesiology residents; there may be bias in data accuracy.

CHAPTER EIGHT: CONCLUSION AND RECOMMENDATION

7.1 Conclusion

In this observational study, patients who underwent elective surgery were observed to determine the magnitude and contributing factors of first-case skin incision delay. The outcome indicated that 56.5% of the initial skin incisions were delayed with a mean delay time of 32.62 minutes. Late induction of anesthesia, lack of anesthesia drugs/adjuvants in the theatre supply room/pharmacy, surgeons' (fellows and residents) late arrival to the operation theatre, type of surgery, and surgical position were identified as associated factors. The finding of the study shows that surgical treatment of more than half of the first cases is not started on the official schedule time. This delay increases hospital stay, acquired infection, morbidity, and mortality.

7.2 Recommendation

- Anesthetists and anesthesiologists should be adherent to on-time anesthesia induction for the first case of the day.
- Fellows and residents in surgery should be on time to the operating room.
- The administrative body of the hospital also should plan an improvement project to reduce first-case skin incision delay and follow consistent drug supply because it contradicts the SaLTS II (2021-2025) strategic intervention to reduce the number of clients on the waiting list for elective surgical service by 50% at the end of 2025(36).
- Future studies should include a qualitative method to address the reasons behind late anesthesia induction, staff punctuality, and drug scarcity.

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ANNEXES

Annex-I Information sheet

Principal Investigator (PI): Mr. Denekew Azene (MSc student)

Advisors: Mr. Geresu Gebeyehu (BSc, MSc in Anesthesia) and Sr Siryet Tesfaye (BSc, MSc in Anesthesia)

Study Title: Magnitude and associated factors of the delayed first case start in elective surgical patients at TASH, Addis Ababa, Ethiopia, 2022/23.

Protocol number: Anes/27////2022/2023

Aim of the study: To assess the magnitude and associated factors of delayed first-case start in elective surgeries.

Confidentiality

If you decide to participate in this study, the researcher will obtain personal information about you including demographic and medical record data. The researcher may give information about you and your health to the Institutional Review Board of AAU. To protect the confidentiality of your information in the records of the study, Information about you and your health that could identify you will be protected through the assignment of serial numbers. Only the researchers will have access to passwords. After this study, researchers will publish their findings. The information will be presented in summary and you will be not identified in publications or presentations.

Risk: We hope that the information from this research may lead to the best estimate of the magnitude and identify associated factors of first-case skin incisions delay of surgical procedures in the institution. This research involves an observational procedure. Risks or social discomforts are not anticipated by the assessment of the magnitude and identifying associated factors with these tools. We believe that there are no known risks associated with this research study.

The benefit of the participant: You may not directly benefit from participating in this study. I hope that the information from this research may lead to timely surgical treatment for patients undergoing surgery in the future.

Annex-II Consent form

This informed consent form is for all who undergoing surgery in the first cases and who we are inviting to participate in research that gathers information on the magnitude and identifies associated factors of delay in the first-case on-time start of surgical elective patients.

I am _____, a principal investigator (PI) / a trained data collector. The PI is researching the magnitude and associated factors of delay in the first-case on-time start of surgical elective patients. I am going to give you information and invite you to be part of this research. Before your decision, you can talk to anyone you feel about the research. There may be some words that you do not understand, please ask me to stop as we go through the information and I will take time to explain.

Your participation is significantly important to assess the magnitude and associated factors of delayed first-case skin incisions of surgical elective patients. All information you provide will be kept confidential. We will not include any identifiers, such as your name or exact address. Your role in the success of the research is important and I appreciate your contribution to the research. Would this be okay with you? **A. Yes** (proceed with the data collection.) **B. No**

When signing this form, I agreed to voluntarily enter this study. I have had a chance to read this consent form, and it was explained to me in a language that I use and understand. I have had the opportunity to ask questions and have received satisfactory answers. I understand that I can withdraw at any time.

Participant/Parent Name: Signature: Date

_____ _____ _____

Data Collector Name: Signature: Date

_____ _____ _____

Name of PI: Denekew Azene Amogne

Address: Phone = +251921875804; Email = denekewazene@gmail.com

Thank you for your time and volunteer!

የመጠይቅ ፈቃድ ቅጽ

የተከበራችሁ የጥናቱ ተሳታፊዎች

የዚህ ጥናት ዋና አላማ በ2015 ዓ.ም በጥቁር አንበሳ ስፔሻላይዝድ ሆስፒታል በመጀመሪያ ቀዶ ጥገና በተሰራላቸው ታካሚዎች ላይ ቶሎ ያለመጀመር ሁኔታና ተያያዥ ጉዳዮችን ለማወቅ ነው:: በኢጋጣሚ እርስዎም በዚህ ጥናት እንዲሳተፉ ተመርጠዋል፡፡ የዚህ ጥናት ጥቅም እርስዎ በሚሰጡት ምላሽ መሰረት መረጃዎችን በማጠናቀር ውጤቱን እየተሰራበት ካለው ጋር ለማገናዘብ እንዲቻል ነዉ፡፡ ጥናቱ በትክክል አላማውን እንዲመታ የእርሶዎን ድጋፉ እንጠይቃለን፡፡ የማንኛውም ግለሰብ ስም አይመዘገብም እንዲሁም ሀሳቡ ብቻውን ይፋ እንዲዎጣ አይደረግም:: ሙሉ በሙሉ በሚስጥር የተጠበቀ ነው፡፡ በጥናቱ መሳተፍ አለመሳተፍ የራስዎ መብት ብቻ ነዉ፡፡ ግልፅ የሆነ ምላሽንና ከልብ የመነጨ ተሳትፎዎን እንዲሰጡን በአክብሮት እንጠይቃለን፡፡

ለመሳተፍ ፈቃደኛነዎት?

ሀ/ አዎ _____ (ቃለ መጠይቁን መቀጠል ይችላሉ)

ለ/ አይደለሁም_____ (ቃለ መጠይቁን ያቁሙ)

_____	_____	_____
የተሳታፊው ስም	ፊርማ	ቀን
_____	_____	_____
የሱፐርቫይዘር ስም	ፊርማ	ቀን

ለመሳተፍ ፈቃደኛ ስለሆኑ እናመሰግናለን፡፡

Annex III- Questionnaire

English Version

This questionnaire is used for data collection from participants to assess the magnitude and associated factors of delay in the first-case on-time start of surgical procedures among elective surgical patients scheduled on daily lists in TASH, at Addis Ababa, Ethiopia, 2022/23.

Part I: Patient information

S/N	Variables	Responses	
100	Does a patient have a previous history of elective surgery at TASH since January 9/2023?	Yes	If "yes" jump to the 2nd first case.
		No	If "no" continue data collection for this patient
101	Residency area	Urban	Rural
102	Admission status	OPD	IPD
103	ASA physical status	I / II	III / IV
104	Is a patient available around OR reception area before 8:00 am?	Yes	
		No	
105	Has a patient completed the admission process before his/her availability at the reception area?	Yes	
		No	
106	Does a patient have coexisting diseases?	Yes	
		No	
107	Can a patient/family afford OR materials?	Yes	
		No	

108	Does a patient/family take consent before 8:00 am?	Yes
		No
109	Does a patient have a functional IV line before OR entry?	Yes
		No
110	Is an ICU bed indicated/preserved for this patient before OR entry?	Yes
		No
111	Is x-matched blood indicated/ prepared for this case?	Yes
		No

Part II: Facility Information

201	Has the operation room opened at or before 7:00 am?	Yes
		No
202	Is there adequate oxygen in a cylinder before the patient entered the OR?	Yes
		No
203	Is a suction machine functional before patient entry?	Yes
		No
204	Is the anesthesia machine/monitor functional before patient entry?	Yes
		No
205	Are all basic airway equipment (ETT, LMA, Laryngoscope, oral airway, facemask, style) available in OR?	Yes
		No (specify)
206	Are all common anesthesia drugs/adjuvants (propofol, ketamine, atropine, adrenaline, succinylcholine, vecuronium, lidocaine, bupivacaine, dexamethasone, neostigmine) available in the supply room?	Yes
		No (specify)
207	Are fluids (crystalloids) available in a supply room?	Yes
		No

208	Are antiseptic solutions (iodine, alcohol) available in the OR?	Yes
		No
209	Was the electricity interrupted since the patient's entry to the skin incision?	Yes
		No
210	Was the water supply interrupted since the patient's entry to the skin incision?	Yes
		No

Part III: OR Staff Information

301	Have MSc anesthesia students/ anesthesiology residents arrived before 8:00 am?	Yes
		No
302	Has the consultant anesthetist/ anesthesiologist arrived before the patient's entry to the OR?	Yes
		No
303	Have OR Nurses arrived before or at 7:30 am?	Yes
		No
304	Have resident surgeons/fellows arrived before 8:00 am?	Yes
		No
305	Has a consultant surgeon arrived before or at anesthesia induction time?	Yes
		No

Part IV: Anesthesia Information

401	Has a patient entered the OR before or at 8:00 am?	Yes
		No
402	Does a patient have an anticipated difficult airway?	Yes
		No
403	Does a patient have anticipated difficult central neuraxial puncture?	Yes
		No
404		Yes

	Has anesthesia preparation been finished before 8:30 am?	No	
405	Anesthesia technique	GA	ETT
			DLT
			LMA
			Sedation
		RA	Spinal
			Epidural(specify)
			Peripheral(specify)
		Both	
406	Has an arterial line cannula been secured for this patient before the skin incision?	Yes	
		No	
407	Has a CV- line been secured for this patient before the skin incision?	Yes	
		No	
408	Is the anesthesia induction time before or at 8:30 am?	Yes	
		No	

Part V: Surgery Information

501	Specialty	1. Neurosurgery 2. Orthopedics 3. Gynecology 4. GIT 5. Obstetrics 6. Urology 7. Cardiothoracic 8. ENT 9. Others (Endocrine, Vascular, and Maxillofacial

		10. Pediatrics
502	Surgical position of a patient?	1. Supine 2. Others
503	Was a skin incision (procedure start time) after 9:00 am?	Yes (delayed)
		No (not delayed)
504	If the answer for “No. 503” is yes write incision time.	

Thank you for your feedback.

Annex IV: Data collection control format

Mark cells of tables to control the data collection process.

Mark * at a room where daily data collection is going to be started

Mark √ at rooms selected for daily data collection

Mark “X” for rooms in which daily first cases have been canceled

Mark “N” in rooms where there is no daily case-schedule

Mark “A” at rooms other than selected daily data-collecting rooms that have schedules

Mark “E” at a room where a daily data collection ended up

Mark “H” for a room where a patient with previous elective surgical history is in the study period.

SN	Date	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	Total 1^{st} cases

Key: R = room

Annex V: Goodness of fit model using Enter method

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	325.441[a]	0.449	.602

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	4.594	8	0.800