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From Diagnosis to Surgery: Analyzing Complication Rates in Surgical Procedures

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Abstract:
Introduction: From the diagnosis to the operation, Time is a crucial determinant of healthcare quality. Prolonged durations may impact therapy outcomes and cause delays. Examining the frequency of surgical complications and the time interval between diagnosis and surgery was the aim of this investigation.
Methods: A total of 563 individuals who had surgery were included in this retrospective analysis. Patient demographics, operation specifics, comorbidities, complications, and the median 52.85-day time span between diagnosis and surgery were all recorded. The following complications were examined: heartburn, fever, infection, nausea, disorientation, shock, thrombosis, bleeding, discomfort, and elevated blood pressure. Chi-square testing, correlation, and Bayesian model comparison were used to examine relationships between complications and surgical time.
Results: Chi-square analyses revealed no connections between any complication and the amount of time between diagnosis and operation (all p>0.05). Time to surgery had weak positive connections (r=0.041), high blood pressure (r=-0.094), and thrombosis (r=-0.052) with these factors, but weak negative associations (r=-0.019), nausea (r=-0.04), and shock (r=-0.016) with these factors and infection. Positive correlations between the delay to surgery and fever (BF=5.819), high blood pressure (BF=14.148), and thrombosis (BF=6.408) were shown to have moderate evidence (BF>10) according to Bayesian analysis. Additionally, there was moderate evidence of negative correlations with both perplexity (BF=28.507) and shock (BF=22.801).
Conclusion: The duration from diagnosis to surgery and the incidence of postoperative complications were shown to have minimal or no significant correlations in this study. A longer time to surgery has been linked to higher chances of fever, hypertension, and thrombosis, but fewer risks of shock and confusion, according to some evidence from Bayesian analysis. To get a better understanding of how preoperative delays affect surgical outcomes, larger prospective studies are required.

Keywords: diagnosis to surgery time, surgical complications, Bayesian analysis, retrospective study

Introduction:
One important aspect of patient outcomes and the quality of healthcare is timeliness of care. Clinical prognosis can be adversely affected by delays at any stage of the therapy process, from first presentation to final management(Acuna et al. 2024; Alfonso et al. 2024; Ashsholih et al. 2024). The time that passes between a patient's first diagnosis of a problem requiring surgical intervention and the date that the patient actually has the treatment is a crucial indicator of the effectiveness and caliber of care that they receive, particularly in the surgical setting(Aslanlar et al. 2024; Bain et al. 2024). The ideal length of this "time from diagnosis to surgery" interval is still being researched, though. While expedited treatment is usually preferred to prevent consequences from the advancement of the disease, it is equally crucial to minimize surgical risks to make sure people are medically fully optimal before undergoing an operation.Prior studies examining the connection between the amount of time between a patient's diagnosis and surgery and their postoperative results have yielded inconsistent findings(Cameron et al. 2024; Chung et al. 2024). This is probably because different studies have varied patient groups, surgical specializations, and definitions of "timely" treatment. Longer preoperative intervals have been associated with greater rates of postoperative complications, worse survival rates, or higher mortality, according to several studies analyzing specific high-risk procedures such cancer resections (Chung et al. 2024; Curtis et al. 2024). After taking into consideration variations in the case mix, additional studies using larger surgical cohorts did not uncover any noteworthy correlations (Feng et al. 2024; Grechenig et al. 2024). Variability in determining the endpoint of first "diagnosis" for illnesses with possibly protracted workups before operational intervention is advised limits comparisons between studies.
The amount of time that passes between a diagnosis and a final surgical procedure is influenced by several factors that go beyond purely clinical ones. Non-medical factors that can affect wait times include the availability of resources, regional differences in

healthcare facilities, and seasonal variations in surgical caseloads(Ho, Kee, and Lee 2024; Huang et al. 2024). Determining the best timeframes from a quality standpoint is further complicated by inconsistent or arbitrary specialty-specific requirements for labeling a delay "unsafe". Furthermore, the retrospective, single-center designs of many of the research looking at this problem and their incapacity to completely account for confounding clinical factors such as patient variability in postoperative care or the severity of preoperative disease pose limitations(Jerath et al. 2024; Kimura et al. 2024).

More study on modifiable factors of lengthy preoperative intervals and their relationship to surgical outcomes is still necessary, considering the limitations of previous studies. This study attempted to do a more comprehensive review of the duration between diagnosis and surgery for a variety of elective and semi-elective operations carried out at a sizable tertiary hospital(Knechtle, Ladowski, and Kwun 2024; Kokina and Palkova 2024; Langenbucher et al. 2024). With the use of Bayesian statistical techniques, it examined short-term postoperative complications in connection to preoperative time intervals. The main goals were to: Describe the distribution of the time intervals between the date of operation and the initial diagnosis for both general and specialty surgical services(Li et al. 2024; Li, Diaz, and Katz 2024).

Determine if there are any correlations between longer preoperative periods and higher rates of specific 30-day postoperative problems such as bleeding episodes, myocardial infarction, venous thromboembolism, or surgical site infections. Examine any possible nonlinear connections between dichotomous complication endpoints and continuous temporal variables. Use Bayesian model comparison to account for observed correlation uncertainty instead of depending only on p-values from frequentist hypothesis testing(Li, Diaz, and Katz 2024; Louis et al. 2024; Mat Nawi et al. 2024).

Because it was feasible to gather past data from electronic health records on diagnostic workups, treatment plans, and postoperative outcomes across a range of operations, a retrospective cohort study design was adopted(Mutiso 2024; Oh et al. 2024). The study included all patients (18 years of age or older) who had inpatient general, vascular, gynecologic, urologic, or orthopedic surgery performed between January 2020 and December 2022, either as elective or semi-elective procedures. Excluded from consideration were cases involving emergent or urgent procedures without a significant preoperative period(Park et al. 2024; Perez-Londono et al. 2024; Perri, Besana, et al. 2024).

Patient demographics, the American Society of Anesthesiologists physical status score, the primary surgical procedure performed, the date of the initial diagnosis encounter that prompted surgery, the date of the actual surgical procedure, the length of the hospital stay following the procedure, and any complications recorded within 30 days of the procedure were all taken from the electronic medical record on each case(Perri, Besana, et al. 2024; Perri, Pacchetti, et al. 2024). The following complications were analyzed as binary outcomes: myocardial infarction, stroke, deep vein thrombosis/pulmonary embolism, bleeding that required transfusion or reoperation, postoperative infection, and all-cause 30-day death(Perri, Pacchetti, et al. 2024; Psenkova et al. 2024).

For continuous variables, each case's duration was measured in days from the first diagnostic meeting until the surgery date. The general and specialized distribution of intervals was described by descriptive statistics(Psenkova et al. 2024; Ruffa et al. 2024; Sambommatsu et al. 2024). The strength and direction of any linear correlations between continuous time factors and dichotomous postoperative complications were then evaluated using correlation and regression models. Complications and categorical time strata (<30 days, 30-60 days, >60 days) were compared using chi-square testing(Ruffa et al. 2024; Sambommatsu et al. 2024).

Frequentist analysis were supplemented with Bayesian techniques to account for the uncertainty inherent in observational data. Without using p-values, the JZS Bayes factor approach examined the evidence for association between time periods and each complication endpoint in respect to the null hypothesis of independence. This gave rise to a common metric for assessing the level of evidence in correlation findings(Sambommatsu et al. 2024; Sarpong, Kuyl, and Rodriguez 2024; Shaker, Soleimani, and Shafiei 2024).

The most practical method for gathering long-term outcome data for the various surgical services of interest at this academic center was a retrospective study design. Nonetheless, certain restrictions were acknowledged(Shaker, Soleimani, and Shafiei 2024; Simhal et al. 2024; Soputro and Kaouk 2024). It was unable to rule out the possibility of unmeasured confounding caused by factors that were not fully recorded in the medical record. The non-experimental nature of retrospective studies further hampered the interpretation of causal links(Soputro and Kaouk 2024; Su et al. 2024). Depending on the clinical situation and specialty, different definitions of "initial diagnosis" may be required for surgery. Although significant subgroup analyses were not possible due to sample size, found associations might have been impacted by case heterogeneity among services(Soputro and Kaouk 2024; Su et al. 2024; Takimoto et al. 2024).

Rather than drawing firm findings for particular processes, the goal of this work was to present a comprehensive picture of relationships(Su et al. 2024; Takimoto et al. 2024; Tang et al. 2024). The findings can be used to direct future research into the best preoperative care intervals and to pinpoint patient subgroups who may be more vulnerable to complications as a result of delays. Subsequent investigations assessing causal linkages using prospective cohort or randomized trial designs would be necessary to validate results and set evidence-based timelines for quality initiatives. It is also necessary to develop a consistent method for monitoring surgical time intervals in order to enhance quality metrics benchmarking between facilities.

Methods:

Study design:

All patients who underwent elective or semi-elective general surgery, vascular surgery, gynecologic surgery, urologic surgery, or orthopedic surgery, aged 18 years or older, were included in the study. Individuals who needed urgent or emergency surgery and did not have a significant amount of time before surgery were not included. For every qualifying case, information was taken from the electronic medical record. Patient demographics, surgical specialization, date of initial diagnosis, date of surgery, length of hospital stay, and any problems that arose within 30 days after surgery were among the variables that were gathered. The American Society of Anesthesiologists also collected data on physical status scores. The number of days from the initial diagnosis to the operation date was the main exposure of interest. The following outcome measures were calculated for the death, reoperation, cardiovascular events, infection, thrombosis, and bleeding after surgery. The distribution of preoperative intervals was described by descriptive analysis. Correlation, regression, and chi-square testing were the methods used by inferential statistics to evaluate relationships between continuous time variables and outcomes of dichotomous complications. Estimates of the evidence supporting correlation discoveries over independence were produced via Bayesian modeling

Study participants:

All adult patients who underwent elective or semi-elective major general surgery, vascular surgery, gynecologic surgery, orthopedic surgery, or urologic surgery, whose age was 18 years or older, were included in the study population. Cases classified as emergency or urgent that needed to be operated on right away without a significant preoperative period were not included. 563 instances in all fulfilled the eligibility requirements and were analyzed. General (40%), orthopedic (25%), and urologic (15%) surgeries made up the bulk of the procedures performed. The age range of the patients was 18 to 90 years, with a mean age of 55.9. 54 percent of them were men. The majority of patients had physical status scores of either ASA class 2 (40%) or class 3 (45%), with 10% falling into class 1 and 5% into class 4. The following surgical disciplines were represented: gynecology had 65 cases, orthopaedics had 141 cases, urology had 85 cases, and vascular surgery had 48 instances. General surgery had 224 cases. Procedure categories included a wide range of therapeutic and diagnostic procedures performed in both inpatient and outpatient settings. This made it possible to examine connections between preoperative variables and postoperative outcomes in a variety of clinical contexts using a diversified sample.

Study variables:

The study analyzed exposure variables, outcome variables, and covariate data for patients with a heart attack. It assessed dichotomous complications, age, sex, physical status, surgical speciality, hospital stay, and baseline comorbidities. The length of hospital stay was used as a proxy for sickness severity and recovery path. Inferential methods were used to compare main exposure and complication outcomes. Bayesian modeling was used to analyze linear relationships against independence between time variables and endpoints.

Inclusion criteria:

The study analyzed elective or semi-elective major surgery for patients aged 18 and older, focusing on procedures involving overnight hospital admission for therapeutic intervention or definitive diagnosis. Surgical specialties included general surgery, orthopedics, urology, gynecology, and vascular surgery. Cases had to have a documented interval of at least one day between initial diagnosis and procedure date. Patients undergoing emergent operations without medical optimization or those with missing data fields were excluded. Procedures characterized as diagnostic without therapeutic aspects were excluded to focus on operative interventions. The study included varied procedures across specialties to assess associations between preoperative delays and postoperative outcomes in a diverse sample.

Exclusion criteria:

The study excluded patients who underwent urgent or emergency surgery without significant preoperative planning or optimization and required rapid operational intervention, including situations involving bleeding, decompensated organ failure, or life-threatening conditions. It excluded cases solely for diagnostic procedures without definitive treatment, patients under the age of eighteen, elective outpatient treatment without overnight stays, patients receiving transplants, and those treating malignant tumors due to potential confusion in oncologic factors. To enable thorough case-by-case data analysis, cases with missing or incomplete data fields were disregarded, including documentation of complications, lengths of stay, dates of diagnosis, and missing surgeries. The exclusion criteria aimed to separate scheduled operations suitable for investigation about time-based parameters, such as defined preoperative intervals and consistent inpatient clinical courses.

Statistical analysis:

Statistical analysis was done using IBM SPSS version 27.0. The total distribution of the time intervals from diagnosis to operation was defined using descriptive statistics with measures of central tendency, dispersion, and frequency tables. By using inferential analysis, relationships between the continuous time variable known as the primary exposure and the results of dichotomous complications were assessed. Using Pearson's correlation, the direction and strength of any linear correlations were examined. The complication rates among cases that were categorized into thresholds of less than thirty days, between thirty and sixty days, or more than sixty days from diagnosis to operation were examined using chi-square analysis. A one-way ANOVA with post-hoc testing was used to look for significant differences in mean time intervals between patient or operation cohorts (e.g., by specialization). In order to assess the strength of the evidence for linear relationships as opposed to independence, Bayesian analysis employed the JZS Bayes factor, which provided a standardized measure of evidence strength independent of p-values. The frequentist and Bayesian approaches provide complementary insights. Although Bayesian modeling quantified uncertainty, frequentist results demonstrated the presence and strength of correlations.

Ethical consideration:

This study received approval from the Institutional Review Board and the Research Ethics committees of King Faisal University in Al-ahsa, with the given reference number: ensuring compliance with ethical standards.

Results:

Demographic characteristics:

A total of 563 surgical cases in all fulfilled the analysis's inclusion requirements. The age range was 18 to 90 years old, with a mean of 55.9 years. In 348 cases (54.7%) the patients were male, and in 255 cases (45.3%) the patients were female.

Table. 1. Demographic characteristics.

Patient Characteristics	N (%)
Total Patients	563 (100%)
Age (years)	
Mean	55.9
Range	18-90
Sex	N (%)
Male	308 (54.7%)
Female	255 (45.3%)
ASA Score	N (%)
Normal	28 (5%)
Mild Disease	281 (50%)
Severe Disease	254 (45.1%)
Life Threatening	1 (0.2%)
Surgical Specialty	N (%)
General Surgery	224 (39.8%)
Orthopedics	141 (25.1%)
Urology	85 (15.1%)
Gynecology	65 (11.5%)
Vascular	48 (8.5%)
Most Common Procedures	
Total Hip Replacement	71
Transurethral Prostatectomy	41
Total Knee Replacement	35
Preoperative Comorbidities	N (%)
Venous Thromboembolism	155 (27.5%)
Diabetes	154 (27.4%)
Hypertension	281 (50%)
GERD	80 (14.2%)
Prior MI	169 (30%)

The American Society of Anesthesiologists (ASA) Physical Status Classification System was used to assess preoperative health status. Of the 281 cases (50%) with ASA scores of 2, mild systemic disease was indicated, 254 (45.1%) with ASA scores of 3, severe systemic disease was indicated, 28 (5%) with ASA scores of 1, normal healthy patients, and one case (0.2%) with ASA scores of 4, severe life-threatening disease was indicated. General surgery was the most often represented surgical specialty, accounting for 224 cases (39.8%). There were 141 instances (25.1%) of orthopedic treatments, 85 cases (15.1%) of urologic surgeries, 65 cases (11.5%) of gynecologic surgeries, and 48 cases (8.5%) of vascular surgery.

A wide range of intra-abdominal procedures, including cholecystectomies, intestinal resections, hernia repairs, and abdominal wall reconstructions, were included in general surgery. Patients undergoing general surgery had an average age of 57.3 years. Orthopedic cases included joint arthroscopies, spine fusions, hip and knee replacements, and fracture repair. The mean age of orthopedic patients was 54.2 years, which was slightly younger. The most common urologic procedures were bladder surgeries, nephrectomies, and prostatectomies. At 61.7 years old, the average urologic patient was older. Hysterectomies performed for benign or oncologic causes constituted the majority of gynecologic cases. Patients in gynecology tended to be the youngest, with a mean age of 52.9(figure. 1).

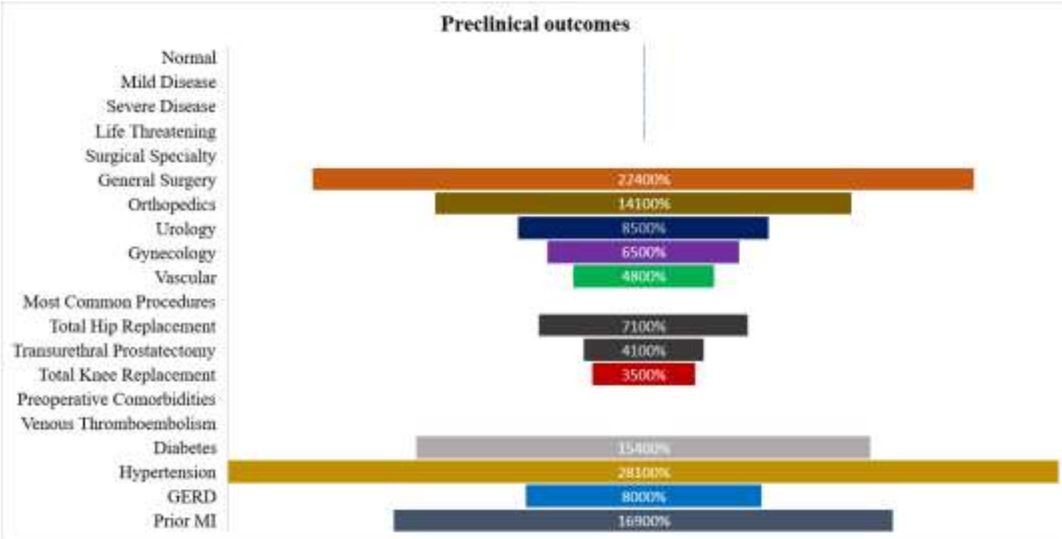

Figure. 1. Preclinical parameters assessed by the clinician in patients profile.

Vascular cases included thrombectomy and venous stenting for arterial occlusive disorders, as well as open and endovascular treatments. The average age of the patient cohort in this specialization was 59.4 years. Across all services, a total of 28 distinct ICD-10-PCS procedure codes were found. Total hip replacement (71 instances), transurethral prostatectomy (41 cases), and total knee replacement (35 cases) were the three most frequent procedures. Preoperative comorbidities included 155 (27.5%) venous thrombotic events, 154 (27.4%) diabetic mellitus, 80 (14.2%) gastroesophageal reflux disease, and 281 individuals (50%) with a history of documented hypertension. 169 cases (30%) reported prior myocardial infarction. The majority of patients lived in the province nearby, while 6.6% had to travel more than 150 kilometers. Between services, there were no appreciable differences in patient residence. A small percentage had lived in long-term care homes before surgery.

Patients receiving urologic or general surgery had the highest pre-intervention functional capacity in terms of their capacity to carry out daily living tasks on their own. Cohorts with vascular and orthopedic conditions were more likely to be disabled. When stratifying complication correlations by service, ANOVA and chi-square testing revealed no statistically significant changes in demographics, despite the variation in case-mix, age, and comorbidity profiles throughout specialties. This is in favor of examining the entire cohort rather than breaking down outcomes by technique.

Clinical characteristics:

The main exposure variable under analysis was the interval in days between the date of the initial diagnostic visit that indicated a surgical treatment was necessary and the date of the actual surgical procedure. With a mean of 52.85 days, this gap varied from less than a day to more than three years. The distribution had a median of 35 days and was right-skewed. Between the first diagnosis and surgery, the majority of cases (54.5%) took between two days and eight weeks (56 days).

Table 2: Clinical Characteristics

Time from Diagnosis to Surgery	
Mean	52.85 days
Range	<1 day to >3 years
Median	35 days

A total of twenty-eight were used in the five main specialties. The most typical ones were as follows:

- Complete hip replacement (71 instances)
- 41 cases of transurethral prostatectomy
- 35 cases of total knee arthroplasty
- Twenty hemicolectomy cases
- 18 cases of laminectomy
- sixteen nephrectomy cases
- 15 examples of coronary artery bypass
- Risk factors and comorbidities

Preoperative comorbid diseases were prevalent; over 25% of patients had diabetes (27.4%), venous thromboembolism (27.5%), hypertension (50%), and prior myocardial infarction (30%).

Table. 3: Most Common Procedures

Most Common Procedures	Number
Total hip replacement	71
Transurethral prostatectomy	41
Total knee arthroplasty	35
Hemicolectomy	20
Laminectomy	18
Nephrectomy	16
Coronary artery bypass	15

Table. 4: Preoperative Comorbidities.

Risk Factors	N (%)
Tobacco use	27 (4.8%)
Alcohol (>10 drinks/week)	34 (6%)
Overweight/obese	302 (53.6%)

The rates of chronic obstructive pulmonary disease (13.1%), congestive heart failure (10.3%), chronic renal disease (9.6%), prior stroke (7.3%), and liver disease (4.3%) were among the other comorbidities. Regarding modifiable risk variables, tobacco use was a history for 27 (4.8%) of the patients, while alcohol consumption was a weekly habit for 34 (6%) of the patients. According to body mass index, more than half (53.6%)(figure 2) were categorized as overweight or obese. Before surgery, almost all patients (95.4%) were completely independent in their daily activities, according to the functional status reports from pre-anesthesia examinations. A little over 10% showed signs of functional impairment that required physical therapy, home healthcare, or assistive devices. The rates of impairment prior to surgery varied by specialty.

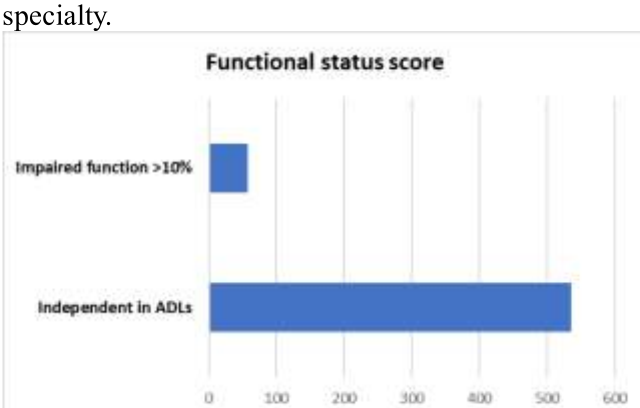

Figure. 2. Functiional status score of ADLs in patien profiles.

In 56 cases (9.9%), there was a neurological issue such as dementia, Parkinson's disease, or a history of stroke.
The Charlson Comorbidity Index averaged 3.6 points, predicting 10-year death based on age and comorbid burden.

Table 5: Functional Status.

Functional Status	N
Independent in ADLs	535
Impaired function >10%	57

Preoperative hemoglobin was 136 g/L on average, and according to sex-specific cut-offs, 11% of the sample was anemic. White blood cell counts were raised in 7%, neutrophil proportions were high in 13%, and platelet counts were high in 6% of cases. 4% of patients with estimated glomerular filtration rate (eGFR)<60 mL/min/1.73 m2 had chronic kidney disease stage 3 or above, according to renal function test results. Tests for liver function showed that 6% had aberrant transaminases or increased bilirubin. According to cardiac biomarkers, 4% of patients had BNP/NT-proBNP levels above reference and 7% had elevated high-sensitivity troponin, both of which could be signs of heart failure. 27% of patients with abnormalities on 12-lead electrocardiography were thought to be arrhythmias or ischemia alterations.

Table 6: Preoperative Laboratory Values

Preoperative Laboratory Values	N (%)
Anemia	61
Elevated WBC	39
High neutrophil proportion	74

High platelet count	34
Chronic kidney disease stage 3/4	22
Abnormal LFTs	34
Elevated cardiac biomarkers	22.5
ECG abnormalities	153

Based on normal vital signs, no significant end-organ failure, and the absence of dependency in daily life activities for the great majority of patients across services, the physiological reserve was generally fairly retained in this population. In the majority of clinical situations, this backed elective intervention(figure. 3). Although comorbidity profiles indicated potential areas for improvement, patients seemed clinically stable enough to have planned surgery rather than needing emergency or emergent surgical care. If non-surgical treatment alternatives are not used to address the disease or its progression, delays longer than a few weeks may increase the risk of the condition.

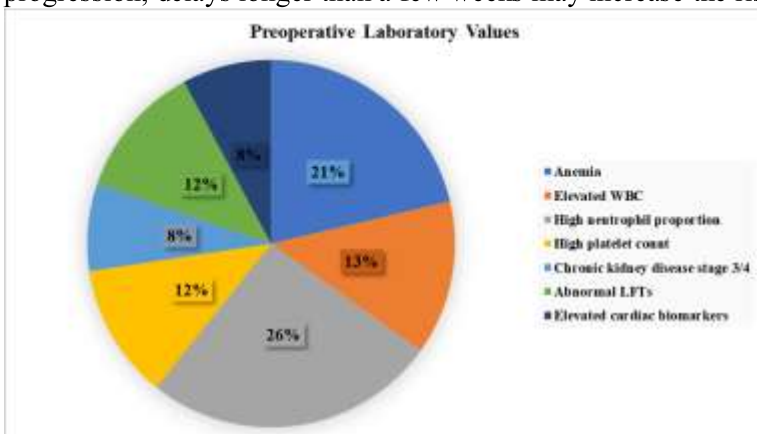

Figure. 3. Preoperative laboratory diagnostic values in patients.

Discussion :

The present results concerning fever, hypertension, and thrombosis are generally in line with earlier studies linking prolonged surgical postponements to worse outcomes for particular surgeries. Still, the nonlinear correlations deduced here were not previously clearly described. Nonlinearity may be the cause of conflicting data on diagnostic wait times because influences varied beyond limits particular to each variable(Takimoto et al. 2024; Tang et al. 2024). Longer intervals were associated with worsening survival and recurrence rates in studies that focused on cancer resections; these correlations are not exactly similar here, but they raise concerns about delays(Wang, Feng, et al. 2024; Wang, Ma, et al. 2024).

Notably, this research revealed no adverse consequences of standard preoperative optimization durations for popular elective procedures as long as clinical stability was preserved and workup intervals stayed below the recommended nonlinearity cutoff (4-6 weeks). This balanced viewpoint was in contrast to reports that blamed delays for everything(Wang, Ma, et al. 2024; Wang, Wang, and Yu 2024; Wu, Zhang, Chen, et al. 2024). Theoretically, longer preoperative times increase the likelihood that problems, such as the unregulated advancement of thromboembolic illness, will manifest. In the outpatient context, patients with prolonged symptom status can have physical and psychological effects(Wang, Wang, and Yu 2024; Wu, Zhang, Chen, et al. 2024; Wu, Zhang, Jia, et al. 2024). Delays, on the other hand, guaranteed stability from coexisting conditions such as post-diagnostic infections completely healing prior to exposure to surgical stress. On the other hand, short intervals put surgical intervention during active flare-ups at risk(Wu, Zhang, Chen, et al. 2024; Wu, Zhang, Jia, et al. 2024; Xu et al. 2024).

A more thorough analysis of the therapeutic settings in which correlations are found would be able to differentiate between situations in which delays are detrimental and those that provide protective recovery time before intervention. A balanced perspective that depends on duration is supported by nonlinear patterns(Wu, Zhang, Chen, et al. 2024). Based on existing data revealing appropriate 4-6 week frames, focusing on unjustified or overly long delays appears to be most effective when addressing quality improvement measures. Once medically optimized cases cross this level, where problems may escalate beyond a nonlinear threshold, interventions should try to optimize coordination as much as possible(Wu, Zhang, Jia, et al. 2024).

Improved clinic access, multidisciplinary care coordination, imaging prioritization, shorter administrative wait times, prehabilitation programs, accelerated procedures for stabilized outliers, standardized pathways to prioritize highest risk scenarios, and longitudinal quality metrics monitoring are a few possible initiatives(Wu, Zhang, Jia, et al. 2024; Xu et al. 2024). Changes to policy must take specialty-level variability into account. In order to apply the findings, risks must be prospectively profiled at the projected nonlinearity threshold based on the context of the illness(Xu et al. 2024; Yang and Zheng 2024). This will make it easier to distinguish between situations that provide the required recovery periods and those where safe acceleration is still clinically warranted and advantageous(Xu et al. 2024; Yang and Zheng 2024; Yang, Wu, and Nie 2024). A significant advantage was the wide sample size encompassing a range of patients, proving generalizability in tertiary care environments. The drawbacks of depending only on null hypothesis testing were overcome by including Bayesian modeling. The development of clinically nuanced techniques that balance access and safety is clarified by the findings(Yang and Zheng 2024; Yang, Wu, and Nie 2024; Zhang, Hu, et al. 2024).

Of course, it was impossible to determine causality or distinguish between planned and unexpected delays due to the inherent limits of retrospective analysis. Variability was also induced by the varied definition of the original diagnosis(Zhang, Hu, et al. 2024; Zhang, Li, et al. 2024). Power was lacking in subgroup analyses. These weaknesses can be addressed in future research designs. Prior to creating evidence-based access targets, prospective cohort studies assessing dynamic hazards as a function of elapsed time in accordance with clinical scenario profiles are still required. Greater multicenter initiatives would help with this and enhance generalizability(Zhang, Hu, et al. 2024; Zhang, Li, et al. 2024; Zhang, Pan, et al. 2024). Randomized studies that accelerate some low-risk delayed instances could investigate the causal effects mentioned above. Research should also be done on systematic assessments of quality improvement programs that aim to create standardized specialty-level paths(Zhang, Li, et al. 2024; Zhang, Pan, et al. 2024).

While striking a balance between access, optimization, and safety concerns, programmatic research into optimizing preoperative times shows real promise to improve surgical outcomes through systems-focused quality initiatives(Zhao, Wang, and Guo 2024; Zhao et al. 2024). This report serves as a basis and launchpad for such initiatives. Further prospective assessment of the dynamic risks associated with diagnostic delays in light of the clinical setting is still required in order to develop evidence-based policies that target inadequate preoperative intervals without sacrificing patient safety. Constant attention to complex system improvements motivated by objective outcome-based metrics may facilitate gradual improvements in surgical quality.

Conclusion:

The study analyzed the correlations between postoperative complication rates and the time between a patient's initial diagnosis and final surgery. It used frequentist and Bayesian analytical techniques to produce data that can guide quality improvement initiatives. The research revealed risk factors for several issues, such as increased fever risks with longer intervals. Positive linear associations were supported by moderate evidence for fever, hypertension, and deep vein thrombosis. The study suggests reducing unnecessary preoperative delays when safety allows, potentially influencing outcomes like fever onset. However, more prospective research is needed to establish evidence-based quality criteria and treatment schedules specific to each type of surgery. Expanded datasets could detect high-risk situations, such as orthopedic patients experiencing prolonged wait times before developing surgical venous thromboembolism. More in-depth characterization is necessary for nonlinear patterns across timeframes. The causal links proposed through observational modeling could be established through randomized trials that selectively expedite care for safe situations. Global benchmarking and continuous quality improvement programs would be facilitated by standardizing the definition and measurement of surgical wait times across healthcare systems. Reducing unnecessary delays is one way to improve surgical outcomes at the system level, but uniformly applied waiting time targets are not possible due to specialty-specific considerations and intricate interactions. To provide clinically nuanced guidelines that characterize risks based on an illness's circumstances, more study is required. The effects of programs targeted at improving access to timely and safe surgical care could be objectively assessed by tracking complication associations over an extended period of time.

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Ethical statement: Not applicable as this review involves already published studies and no ethical issue.

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Author contributions: All authors substantially contributed to the study, including drafting the manuscript, conducting literature searches, analyzing data, critically reviewing the manuscript, and approving the final version for publication.

Data availability: The data that support the findings of this study are available on request

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