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Evaluation of routine preoperative testing practices in Sudanese public hospitals 2024: a multicenter prospective study

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Abstract

Background The practice of routine preoperative testing is common in clinical settings despite the presence of regulatory guidelines, straining patients financially and further delaying delivery of care. This study aimed to assess the practice of routine preoperative investigations and compliance with the National Institute for Health and Care Excellence (NICE) guidelines for preoperative investigations in Sudan.

Methods A prospective multicenter study was conducted in the main public hospitals at Atbara, Shendi, and Port-Sudan in January 2024; we prospectively studied 90 adults, sampled by covering all consecutive patients who underwent elective operations during the study period. Data were collected during the preanesthetic check-up and evaluated by senior clinicians for compliance with the NICE guidelines.

Results The study included 39 females (43%) and 51 males (56%), with a mean age of 38 ± 14 years. Among the 90 patients, 89 (99%) underwent at least one unnecessary investigation. Overall, out of 586 requested investigations preoperatively, 312 (53.2%) were unnecessary according to the NICE guidelines. The predictors of requesting unnecessary investigations were ASA status (*p* value 0.020) and surgery grade (< 0.001).

Conclusion This study reported significant overutilization of preoperative testing in Sudanese public hospitals. To address this issue, it is crucial to acknowledge widely recognized guidelines, raise clinicians' awareness of them and monitor their implementation.

Keywords Preoperative investigations, Routine testing, NICE Guidelines, Compliance, Unnecessary investigations

Introduction

Routine preoperative investigations are commonly requested in the clinical setting despite the negative recommendations and clear note in the National Institute for Health and Care Excellence (NICE) guidelines that routine investigations are not needed for all patients (Overview | Routine preoperative tests for elective surgery | Guidance | NICE. n.d.; Recommendation| Routine preoperative tests for elective surgery | Guidance | NICE. n.d.). Patients admitted to the hospital for elective surgery commonly undergo preoperative investigations, such as complete blood count (CBC), renal function tests, blood glucose level tests, urinalysis, chest X-ray (CXR) and electrocardiography (ECG) (Ferrando et al. 2005), and their fitness and appropriateness of the surgery are assessed (Böhmer et al. 2014).

The use of routine laboratory investigations before elective surgery is beneficial and cost-effective when they are correlated with the patient's history and physical examination, resulting in better detection and determination of comorbidities, and are often required to supplement

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information for perioperative risk stratification (Böhmer et al. 2014).

Despite the benefits of preoperative investigations, 60–70% of laboratory tests ordered before general surgery are not required (Soares Dde et al. 2013; Mathias and ST 2006), and up to 90% of patients are subjected to at least one unnecessary investigation (Karim et al. 2016). This can cause delays in treatment, inefficiency in planning surgical care and high costs of health care services (Overview | Routine preoperative tests for elective surgery | Guidance | NICE. n.d.; Recommendation| Routine preoperative tests for elective surgery | Guidance | NICE. n.d.).

The practice of unnecessary preoperative investigations varies according to the type of investigation requested, the presence of local guidelines and the health personnel who request them (Ranasinghe et al. 2010). Note that most laboratory and diagnostic tests (e.g., hemoglobin, potassium, coagulation studies, chest X-rays, and electrocardiograms) are not routinely necessary unless a specific indication is present (Admass et al. 2022). The presence and application of guidelines significantly reduce the cost, as a recent analysis estimated a 63% reduction in cost per patient for preoperative tests by introducing guideline criteria (Ferrando et al. 2005).

The present study aims to provide evidence of unnecessary or uncovered requests for preoperative investigations. The development of an evidence-based working protocol could make the actions of the physicians or divisions more predictable and presumably of higher quality and reduce unnecessary tests that may lead to extra cost burdens, delays in surgery and occasional harm to the patient.

Materials and methods

This prospective hospital-based multicenter study was conducted in three main public hospitals located in Atbara and Shendi in the River Nile State and in Port-Sudan in the Red Sea State. Although the conflict in Sudan has affected the nation broadly, these particular provinces have remained relatively safer compared to other regions. Consequently, a significant portion of the displaced population has migrated to these areas, placing added strain on local healthcare systems. These three hospitals are among the largest and better-functioning facilities in their respective states and are now serving an expanded patient base due to the influx of displaced individuals. While precise estimates of the newly served population are not available, local hospital administrators report a marked increase in admissions and outpatient visits since the start of the conflict, underscoring the critical need for efficient and cost-effective healthcare practices in these settings.

A formal sample size calculation was not performed due to the ongoing conflict and limited resources. Instead, we chose a 1-month period (January 2024) and enrolled every adult patient who underwent elective surgical procedures during that time (a total coverage or "census" approach), while those who underwent emergency surgeries were excluded. This timeframe was selected because it reflected the typical volume of elective surgeries performed at the three hospitals in an average month, while also balancing the logistical challenges posed by the war and restricted resources.

Data were collected by trained data collectors who assessed each patient during the preanesthetic checkup via a structured data collection sheet to report patient age, sex, comorbidities, American Society of Anesthesiologists (ASA) class, grade of the operation and the requested preoperative investigations. The data were reviewed by a team of senior clinicians at one time to decide whether a test was necessary according to the National Institute for Health and Care Excellence (NICE) guidelines for preoperative investigations or not (Overview | Routine preoperative tests for elective surgery | Guidance | NICE. n.d.; Recommendation| Routine preoperative tests for elective surgery | Guidance | NICE. n.d.).

The data were cleaned and entered into Microsoft Excel, after which they were imported and analyzed via IBM SPSS software version 28 (IBM Corp., Armonk, NY). Analysis of variance (ANOVA) was used to compare the rates of unnecessary preoperative investigations across different variables, and a p value of < 0.05 was considered statistically significant after all the rules of statistical tests and confidence levels were assumed.

Ethical approval for conducting this study was obtained from the Sudan Medical Specialization Board (SMSB), and further approval from the hospitals' administrations was obtained. Informed consent was obtained from each participant, and the data were used only for research purposes and intentionally kept confidential.

Results

This study included 90 patients who underwent elective surgical operations in Sudan in 2024 (Fig. 1, Appendix 1). The mean age of the patients was 38 ± 14 years, 39 (43%) were female, and the majority of the patients were from Atbara (43%, 47.8%) (Table 1).

Diabetes was the most common comorbidity (19, 21%), followed by cardiovascular diseases (9, 10%) and respiratory diseases (8, 9%). Among the ASA patients, the majority were class I, constituting 67 (74.5%), while 18 (20%) were class II, and 5 (5.5%) were class III. Surgeries

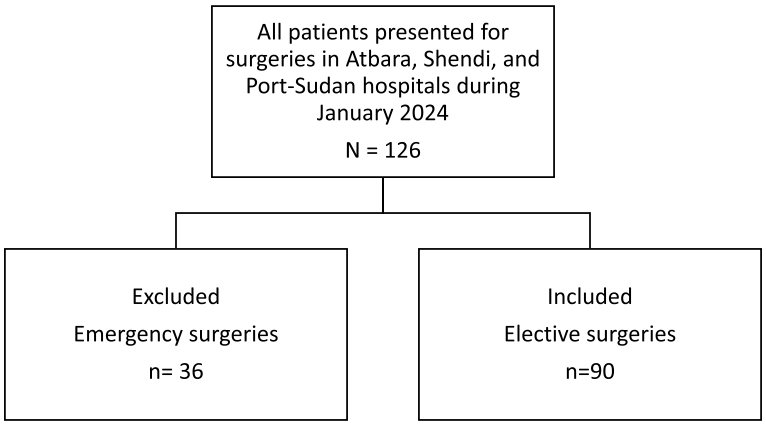

Fig. 1 STROBE diagram showing a schematic illustration of participant flow in this study. CBC: complete blood count; RBG: random blood glucose; RFT: renal function test; Electrolytes: electrolyte panel; LFT: liver function test; Coagulation profile: Coagulation profile; UG: urine general; FBG: fasting blood glucose; ECG: electrocardiogram; CXR: chest X-ray; Echo: echocardiogram

Table 1 Demographic characteristics of patients who underwent elective surgeries in Sudan ($n=90$)

Character	Number (%)
Age	38 ± 14
Gender	
Male	51 (56.7%)
Females	39 (43.3%)
Residence	
Atbara	43 (47.8%)
Port Sudan	21 (23.3%)
Shendi	26 (28.9%)
Comorbidities	
Diabetes	19 (21%)
Cardiovascular diseases	9 (10%)
Respiratory diseases	8 (9%)
ASA class	
ASA Class I	67 (74.5%)
ASA Class II	18 (20%)
ASA Class III	5 (5.5%)
Grade of surgery	
Minor surgeries	22 (24.4%)
Intermediate surgeries	23 (25.5%)
Major surgeries	45 (50%)
Professional level of requester	
House officer	14 (15.6%)
Medical officer	18 (20%)
Junior registrar	30 (33.3%)

ASA American Society of Anesthesiologists

were minor in 22 (24.4%) patients, intermediate in 23 (25.5%) patients, and major in half of the patients. All investigations were requested by surgeons, and their professional degrees were as follows: house officer, 14 (15.6%); medical officer, 18 (20%); junior registrar, 30 (33.3%); and senior registrar, 28 (31.1%) (Table 1).

With respect to preoperative investigations, a complete blood count (CBC) was requested for all patients; however, half of them were unnecessary. Among the 50 (55.6%) and 19 (21.1%) patients who requested random blood glucose (RBG) and fasting blood glucose, 31 (62%) and 9 (47.4%) were unnecessary, respectively. Renal function tests (RFTs) and electrolytes were requested for 67 (75.4%) and 62 (69%) patients, respectively, and 35 (52.2%) and 35 (56.5%) patients, respectively, were unnecessary. All coagulation profile 19 (21.1%) and urine general (UG) 77 (85.6%) tests were unnecessary. Half of the patients were requested to perform an electrocardiogram (ECG), and 17 (19%) were unnecessary. Chest X-ray (CXR) was requested in 49 patients (54.4%), the majority of whom were unnecessary 40 (81.6%). Echocardiography was requested for 13 (14.4%) patients, and 4 (31%) were unnecessary. Only liver function tests (LFTs) 14 (15.6%) and viral screenings 81 (90%) were requested when necessary. Overall, out of 586 requested investigations preoperatively, 312 (53.2%) were unnecessary according to the NICE guidelines (Table 2 and Fig. 2). Among the 90 patients, 89 (99%) underwent at least one unnecessary investigation.

The predictors of requesting unnecessary investigations were ASA status (p value 0.020) and surgery grade (< 0.001); however, the difference between professional levels was not statistically significant (p value 0.075) (Table 3).

Discussion

Preoperative investigations are known for providing opportunities to build good doctor–patient rapport, allowing the systematic identification of patients at risk

Table 2 Preoperative investigations of patients who underwent elective surgeries in Sudan ($n=90$)

Investigation	Requested	Unnecessary
CBC	90 (100%)	45 (50%)
RBG	50 (55.6%)	31 (62%)
RFT	67 (75.4%)	35 (52.2%)
Electrolytes	62 (69%)	35 (56.5%)
LFT	14 (15.6%)	0
Coagulation profile	19 (21.1%)	19 (100%)
UG	77 (85.6%)	77 (100%)
Viral screening	81 (90%)	0
FBG	19 (21.1%)	9 (47.4%)
HbA1c	0	
ECG	45 (50%)	17 (19%)
CXR	49 (54.4%)	40 (81.6%)
Echo	13 (14.4%)	4 (31%)
Overall	586	312 (53.2%)

CBC complete blood count, *RBG* random blood glucose, *RFT* renal function test, *Electrolytes* electrolyte panel, *LFT* liver function test, *Coagulation profile* coagulation profile, *UG* urine general, *FBG* fasting blood glucose, *HbA1c* hemoglobin A1c (glycated hemoglobin), *ECG* electrocardiogram, *CXR* chest X-ray, *Echo* echocardiogram

of adverse perioperative events and the implementation of targeted interventions to optimize favorable perioperative outcomes (Omole et al. 2021; Wijeysundera 2011; Mata et al. 2012). However, unnecessary preoperative investigations may lead to delays in operative treatment and put greater economic burdens on patients, especially in low-income countries such as Sudan. Therefore, this study was conducted to assess adherence to the NICE guidelines for preoperative investigations in Sudan 2024.

The study revealed that over half of the preoperative investigations requested prior to surgery were unnecessary, underscoring the overutilization of these tests. Additionally, 99% of the patients underwent at least one unnecessary investigation. Our findings are consistent with recent reports, such as those of Keshavan et al., who reported that unindicated investigations made up 52% of the total investigations in their study (Keshavan and Swamy 2016); moreover, Karim et al. reported that 89.33% of patients were subjected to at least one unnecessary investigation preoperatively (Karim et al. 2016).

The pattern of unindicated investigations showed some variations in this study; the best adherence was reported with the LFT and electrocardiography liver function tests, whereas the worst adherence was reported with random blood glucose (RBG), coagulation profile, urine general and chest X-ray. This variation was also reported by Ranasinghe et al., who reported that only urinalysis and arterial blood gases demonstrated good adherence to the guidelines (Ranasinghe et al. 2010). The high proportion of unnecessary investigations and the unexplained variation in compliance with the recommended guidelines support that these unindicated tests have no or little impact on clinical decisions or preoperative management (García-Miguel et al. 2003; Bader and Pothier 2009).

Another potential factor that may influence preoperative behavior is the patient's ASA status, as patients with Grade III disease are less likely to undergo unnecessary investigations, indicating that Grade I and II patients are more prone to undergo unnecessary testing. This indicates poor risk alignment and may be an awareness of the risk stratification and how to tailor preoperative testing accordingly.

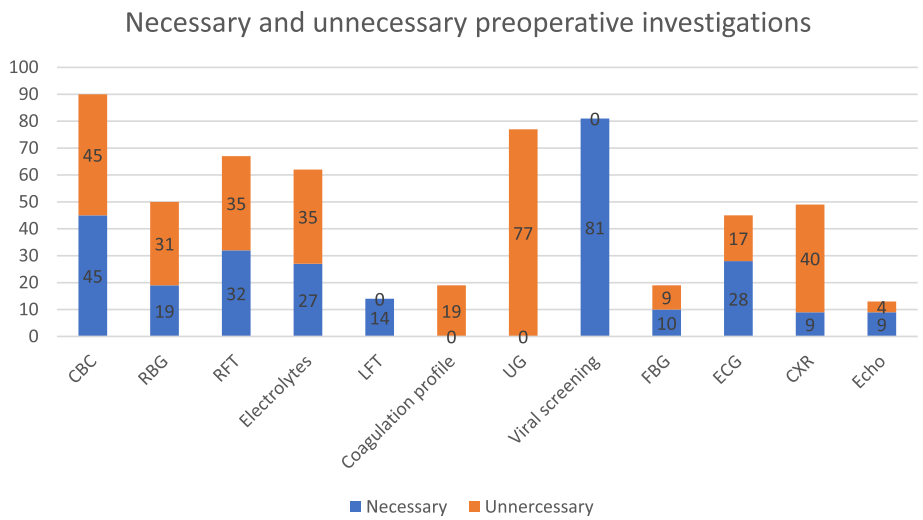

Fig. 2 Necessary and unnecessary preoperative investigations of patients who underwent elective surgeries in Sudan ($n=90$)

Table 3 Predictors of unnecessary preoperative investigations of patients who underwent elective surgeries in Sudan ($n=90$)

Factor	% unnecessary investigations	95% CI of mean (%)	*F*	*p* value
ASA status			4.086	0.020
I	60 ± 28	(53.3–66.7)		
II	62 ± 24	(50.9–73.1)		
III	25	–		
Surgery grade			56.223	< 0.001
Minor	87 ± 13	(81.6–92.4)		
Intermediate	66 ± 12	(61.1–70.9)		
Major	36 ± 23	(29.3–42.7)		
Level of profession			2.377	0.75
House officer	72 ± 38	(52.1–91.9)		
Medical officer	60 ± 31	(45.7–74.3)		
Junior registrar	54 ± 18	(47.6–60.4)		
Senior registrar	49 ± 28	(38.6–59.4)		

ASA American Society of Anesthesiologists

In the study hospitals, patients presenting for elective surgery were typically first evaluated in the surgical outpatient department by a house officer or medical officer. These junior clinicians usually initiated the ordering of investigations, with senior clinicians reviewing the test requests at a later stage (e.g., during pre-anesthetic assessment). This workflow could explain, in part, why lower ASA (i.e., healthier) patients were more likely to undergo unnecessary testing—because standard or "routine" sets of investigations were ordered upfront by the first-contact team rather than being tailored to individual patient risk.

Interestingly, our analysis indicated that the professional level of the person requesting the tests was not a statistically significant predictor of unnecessary testing. This may suggest that the pattern of overutilizing preoperative investigations is pervasive across all clinical ranks, rather than being driven solely by less experienced practitioners. Consequently, efforts to reduce unnecessary investigations should target all levels of medical staff—ranging from house officers to senior registrars—through standardized protocols, improved training, and systematic reinforcement of guideline-adherent practice.

The inevitable and untested impact of this practice is the financial burden on patients; economic analyses suggest that substantial cost savings can be achieved by aligning preoperative testing practices with evidence-based recommendations (Obasuyi and Antwi-Kusi 2017; Hinds and Hariharan 2023; Harris et al. 2022). Vogt et al., for example, reported that hospitals could generate approximately $80,000 by eliminating unindicated preoperative tests for the 5100 patients seen at the preoperative clinic annually (Vogt and Henson 1997).

Over-testing before surgery can have substantial economic consequences for both patients and the healthcare system. In resource-limited settings, such as Sudan—where many individuals pay out of pocket for medical services—every additional laboratory or imaging test adds a financial burden. This burden is exacerbated when tests are not strictly indicated by clinical guidelines, since it leads to unnecessary expenses without clear benefit. Hospitals also bear increased operational costs for processing these investigations (e.g., laboratory reagents, staff time, and equipment maintenance), which can divert limited resources from other critical needs. Collectively, these factors underscore that overutilization of preoperative tests not only strains patients financially but also compromises the overall efficiency and sustainability of healthcare delivery.

Another factor potentially driving over-testing is the practice of ordering entire test "bundles." For instance, instead of requesting only hemoglobin, clinicians often order a complete blood count (CBC). In many hospitals, including those in our study, the option to order individual components (e.g., hemoglobin alone) is either not available or not routinely followed, whether for logistical reasons (standard lab panels, automated analyzers) or administrative protocols that default to a full CBC. This limited flexibility can lead to unnecessary test components being performed. Adopting a more targeted approach—where clinicians can selectively request only the test elements that are truly needed—may help reduce unnecessary investigations and their associated costs, particularly in resource-constrained settings.

While this study is the first to provide insight into the practice of routine preoperative testing in Sudan, it is important to acknowledge the presence of several limitations. For example, the small sample size and the limited number of hospitals restrict the generalizability of the results. Moreover, data was collected in 1 month, which might be a short period to capture a representative sample. In addition, the study could have also included other confounders that can influence decision making, such as resource availability, costs of investigations and insurance coverage.

Another limitation of our study is the absence of standardized local guidelines for preoperative testing in Sudan. Consequently, we relied solely on the internationally recognized NICE guidelines, which may not fully reflect local contexts and resource constraints. The lack of a clear national policy or guideline could have contributed to the inconsistent ordering of investigations observed in this study. Furthermore, we did not formally assess interrater reliability among the senior clinicians

who determined whether each investigation was necessary according to the NICE guidelines. Although these experts reviewed the requests together, variations in individual judgment or interpretation could have introduced subjectivity.

Future research should strive to address these limitations by conducting larger, multi-center studies across more hospitals, employing randomized sampling techniques to improve representativeness and strengthen generalizability. Longer-term, longitudinal designs—spanning several months—can capture temporal variations more accurately. Additionally, investigating the causes of over-utilization, including the presence or absence of local guidelines and exploring clinicians' perspectives, will provide valuable insights for refining practice. Crucially, future work should aim to develop and validate locally relevant guidelines that align with Sudan's unique healthcare environment. Finally, incorporating systematic measures of interrater agreement (e.g., Cohen's kappa) will enhance methodological rigor and ensure the reliability of future assessments.

All these findings call for adherence to established guidelines such as those provided by the National Institute for Health and Care Excellence (NICE), which can optimize resource utilization and patient safety. Addressing this overutilization requires a comprehensive approach involving adopting guidelines, educating clinicians about them, and monitoring their implementation.

Conclusion

In conclusion, over half of the preoperative investigations requested in Sudan were noncompliant with guidelines, and almost all patients underwent at least one unindicated test. Importantly, the patient's ASA status and the grade of surgery emerged as significant predictors of unnecessary ordering, suggesting that test requests could be better tailored to actual clinical risk. These findings reveal a trend toward overutilizing these tests, straining patients financially and delaying operative treatment. To mitigate this issue, it is important to adopt recognized guidelines, educate clinicians about their use and importance, and monitor their implementation.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s13741-025-00522-y.

Supplementary Material 1. Appendix 1. STROBE checklist for observational studies.

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Authors' contributions
A. M. formulated the research idea, collected the data and contributed to the drafting of the manuscript. E. A. analyzed the data and contributed to writing the manuscript. Both authors reviewed and approved the final draft.

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Data availability
Data is available upon reasonable request from the corresponding author.

Declarations

Ethics approval and consent to participate
Ethical approval for conducting this study was obtained from the Sudan Medical Specialization Board (SMSB) and the Educational Development Center (EDC). Informed consent was obtained from all participants prior to participation.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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References

Admass BA, Ego BY, Tawye HY, Ahmed SA. Preoperative investigations for elective surgical patients in a resource limited setting: Systematic review. Ann Med Surg. 2022;82: 104777. https://doi.org/10.1016/j.amsu.2022.104777.
Bader AM, Pothier MM. Out-of-operating room procedures: preprocedure assessment. Anesthesiol Clin. 2009;27:121–6. https://doi.org/10.1016/j.anclin.2008.10.001.
Böhmer AB, Wappler F, Zwißler B. Präoperative risikoevaluation - von der routinediagnostik zur patientenorientierten strategie. Dtsch Arztebl Int. 2014;111:437–45. https://doi.org/10.3238/arztebl.2014.0437.
Mathias LADST, Guaratini ÁA, Gozzani JL, Rivetti LA. Exames complementares pré-operatórios: análise crítica. Rev Bras Anestesiol. 2006;56:658.
Ferrando A, Ivaldi C, Buttiglieri A, et al. Guidelines for preoperative assessment: impact on clinical practice and costs. Int J Qual Health Care. 2005;17:323–9. https://doi.org/10.1093/intqhc/mzi039.
García-Miguel FJ, Serrano-Aguilar PG, López-Bastida J. Preoperative assessment. Lancet. 2003;362(9397):1749–57. https://doi.org/10.1016/s0140-6736(03)14857-x.
Harris AHS, Bowe T, Kamal RN, et al. Frequency and costs of low-value preoperative tests for patients undergoing low-risk procedures in the veterans health administration. Perioper Med. 2022;13:33–10. https://doi.org/10.1186/s13741-022-00265-0.
Hinds S, Hariharan S. An economic evaluation of the preoperative investigations for elective surgical patients at a Caribbean tertiary care teaching hospital. Cureus. 2023:9–15. https://doi.org/10.7759/cureus.33528.
Karim HMR, Yunus M, Bhattacharyya P. An observational cohort study on preoperative investigations and referrals: how far are we following recommendations. Indian J Anaesth. 2016;60:552–9. https://doi.org/10.4103/0019-5049.187783.
Keshavan VH, Swamy CMN. Pre-operative laboratory testing: a prospective study on comparison and cost analysis. Indian J Anaesth. 2016;60:838–42. https://doi.org/10.4103/0019-5049.193678.
Mata J, Cabrera S, Valldeperas MI, Fernández S, Aguilar JL, Atanassoff PG. A national survey on current practice of preanaesthetic assessment in elective surgery patients in Spain. Rev Esp Anestesiol Reanim. 2012;59:299–305. https://doi.org/10.1016/j.redar.2012.04.022.
Obasuyi BI, Antwi-Kusi A. Routine preoperative laboratory testing: economic burden on pre-surgical patients. Open J Anesthesiol. 2017;17:15–22. https://doi.org/10.4236/ojanes.2017.71002.

Omole OB, Torlutter M, Akii AJ. Preanaesthetic assessment and management in the context of the district hospital. S Afr Fam Pract. 2021;63(1). https://doi.org/10.4102/safp.v63i1.5357.
Overview | Routine preoperative tests for elective surgery | Guidance | NICE. n.d. https://www.nice.org.uk/guidance/ng45. Accessed 28 Aug 2023.
Ranasinghe P, Perera Y, Abayadeera A. Preoperative investigations in elective surgery: practices and costs at the National Hospital of Sri Lanka. Sri Lankan J Anaesthesiol. 2010;2:29. https://doi.org/10.4038/slja.v18i1.1558.
Recommendation| Routine preoperative tests for elective surgery | Guidance | NICE. n.d. https://www.nice.org.uk/guidance/ng45/chapter/Recommendations. Accessed 28 Aug 2023.
Soares Dde S, Brandão RR, Mourão MR, Azevedo VL, Figueiredo AV, Trindade ES. Relevance of routine testing in low-risk patients undergoing minor and medium surgical procedures. Braz J Anesthesiol. 2013;63:197–201. https://doi.org/10.1016/S0034-7094(13)70215-0.
Vogt AW, Henson LC. Unindicated preoperative testing: ASA physical status and financial implications. J Clin Anesth. 1997;9:437–41. https://doi.org/10.1016/s0952-8180(97)00060-3.
Wijeysundera DN. Preoperative consultations by anesthesiologists. Curr Opin Anaesthesiol. 2011;24:326–30. https://doi.org/10.1097/ACO.0b013e328345d844.

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