ORIGINAL ARTICLE

# Guidelines for Appropriate Preoperative Investigations of Patients for Elective Surgery

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***ABSTRACT***

*Traditionally, all patients scheduled for elective surgery undergo routine evaluation as part of the assessment of fitness for anaesthesia and surgery. In many cases, a large battery of tests is done even in patients who have no history of medical illness and are clinically normal. In the past years, physicians have questioned the usefulness and cost-benefit of performing such routine screening tests in presumably healthy patients. Many have recognized that these tests usually do not detect diseases in persons with no symptoms and a normal physical examination, and hence have little or no impact on the anaesthetic and surgical management or outcome. The current recommendation by developed countries in North America and Europe is that selective (indicated or diagnostic) tests, guided by the patient's health condition, invasiveness of planned surgery and potential for blood loss, is the best method of preoperative assessment and preparation for surgery. Performing routine tests for all surgical patients as a screening tool has been found to be inefficient and not cost-effective. A change from routine to indicated testing has been shown to result in considerable cost-savings to patients and hospitals. Jamaica is a country with limited resources. Therefore, we hope to highlight and implement appropriate preoperative evaluation for surgical patients, and hence to achieve considerable cost-savings to the healthcare system".*

**Keywords:** History, indicated *versus* routine investigations, physical examination, preoperative preparation

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## INTRODUCTION

Preoperative assessment by the anaesthetist is an important part of the perioperative care of patients. The objectives include: identifying any illness which may impact anaesthesia and improving same, developing an appropriate anaesthetic plan, discussing and obtaining informed consent for this plan and allaying patients' anxiety. This assessment must include a thorough history and examination of the patient and review of relevant investigations. Though investigations are part of the assessment of chronic diseases, it has become common practice to order a number of routine tests for healthy patients with no chronic problems, especially elderly patients, based solely on their age. These tests are done to screen patients for previously undiagnosed disease, as it is assumed that the risk of chronic illnesses such as cardiovascular disease and diabetes mellitus are higher in middle-aged and elderly patients. This approach has been challenged, as numerous studies have clearly shown no benefit, and considerable waste of resources for both patients and health institutions. It has been recognized that the best method of screening for disease/s is by a thorough history and physical examination of patients, followed by the investigation of positive findings, rather than a fixed series of screening tests, such as blood, urine, chest radiograph and electrocardiogram. Much research has been done and guidelines developed in various parts of the world and these have shown

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significant cost-savings to patients and institutions, yet rarely negatively impacted patient outcome.

## METHOD

A review of the literature was done to ascertain the following:

- Current guidelines/protocols
- Opinions regarding preoperative laboratory tests for healthy patients undergoing surgery.
- Appropriate preoperative laboratory tests on various groups of surgical patients.
- The effects of abnormal tests on anaesthetic and surgical management, that is, change of anaesthetic management and cancellation of surgery.
- Tests that predicted adverse intra- and/or postoperative effects.
- The cost-effectiveness of preoperative tests for various groups of surgical patients.

This was done to guide the development of local guidelines and to encourage compliance by all medical staff, particularly anaesthetic and surgical personnel at the University Hospital of the West Indies, a teaching and tertiary-care institution. This is expected to result in significant cost-savings. It is hoped that it will be adopted throughout Jamaica.

## OUTCOME

Preoperative investigations have been divided into two categories; routine or screening and, indicated or diagnostic. The American Society of Anesthesiologists (ASA) Task Force on Pre-anaesthesia Evaluation (2002) defined routine tests as "*those done in the absence of any specific clinical indication or purpose. This means that the tests are intended to discover a disease or disorder in an asymptomatic patient and traditionally include a panel of blood, urine tests and chest X-ray and electrocardiogram*". Indicated tests are defined as "*tests done for a specific clinical indication or purpose, eg to confirm a clinical diagnosis, to assess the severity and progress of disease, and effectiveness of therapy*" (1). Indicated (or diagnostic) tests have been found to be more informative about patients' clinical status and to impact perioperative care and outcome than a large number of routine tests. This strategy has therefore, become increasingly accepted world-wide, based on the recommendations by the ASA Task Force and the National Institute for Health and Care Excellence (United Kingdom), which emphasize selective testing, based on clinical evaluation and risk assessment (1, 2). Many retrospective and prospective studies and observations have shown the benefits of the combination of a thorough history, physical examination and indicated laboratory testing (3–40). These are explored below as well as the impact of the introduction of guidelines in some centres (41–47) and suggested opinions and guidelines (48–54). The topic of blood donation and transfusion (autologous and/or allogeneic) remains an important matter for discussion in the preoperative period, especially for those most likely to require transfusion of blood or blood products. In our institution, this is not always discussed, especially during clinic visits before admission for surgery. The inclusion of this matter in this guideline (57–61), serves as a reminder to all doctors who are preparing patients for surgery and interventional procedures.

The value of routine or screening tests, especially for healthy patients, has been downgraded because they: (i) rarely inform of a disease or disorder in asymptomatic patients; (ii) are frequently not present in the patients' notes, and/or not taken into consideration at the time of surgery and (iii) have little or no impact on the surgical or anaesthetic management of patients (3–16). Abnormal blood results, such as mild anaemia or minor changes in electrolyte levels in asymptomatic patients, rarely alter the peri-anaesthetic management and/or affect outcome, even in paediatric and elderly patients (4–7, 11, 17–19). Dzankic *et al* showed that abnormal sodium and creatinine were not as predictive of adverse outcome as the ASA, surgical risk classification and surgical risk (5). One study showed no complications even when indicative tests were abnormal in healthy patients (20) and hence, like other studies supported the abandonment of routine investigations in healthy patients (21–31). Kaplan *et al* assessed the medical records of 2000 patients who underwent elective surgery over a four-month period (32). These patients had several routine tests ordered according to the protocols at that time which included complete blood cell count, differential cell count, prothrombin time, partial thromboplastin time, platelet count, glucose level and six channel chemistries. They found that 60% of these tests would not have been ordered if the basis was only clinical indications. Only 22% revealed abnormalities that might have affected perioperative management. Specifically, of the 96 abnormal test results, 86 would have been indicated based on history or examination findings. Only four of the remaining 10 were clinically significant. Schein *et al* (33) compared 9408 to 9411 patients who underwent cataract operations. The former underwent 9626 cataract operations that were not preceded by routine testing. The latter underwent 9624 that were

preceded by routine testing including; complete blood count, urea, electrolytes, glucose and electrocardiogram (ECG). Their analyses, which were stratified according to age, gender, race, American Society of Anesthesiologists Physical status, and medical history, revealed no benefit of routine testing. Although these patients underwent a relatively non-invasive procedure, they were all elderly patients, with mean ages of 74 ± 8 and 73 ± 8 years, respectively most of whom had one or more chronic diseases. The conclusion of the authors was that "*Routine medical testing before cataract surgery does not measurably increase the safety of the surgery*", but the reviewers deduced that "*preoperative testing might have decreased the likelihood or the severity of the event for 5.9 and 4.2 per cent of intra-operative events in the no-testing and routine testing groups respectively, and for 6.6 and 16.4 per cent of postoperative events in the two groups*". In many other institutions, chest radiograph and ECG tests are routinely done in healthy patients, even the healthy ASA 1 elderly patients (> 65 years). These tests did not impact the anaesthetic or surgical management, but increased cost to the patients and/or the institution (7, 11, 16, 34–35).

The cost of routine tests is substantial (3, 7, 9, 10, 13, 16). A review of preoperative testing in general surgical patients reported that 300 tests were ordered for 142 patients undergoing 155 procedures. Only 125 (42%) of these tests were considered indicated based on clinical criteria and 54 (43.2%) of these were abnormal, as compared to 21.7% abnormal routine tests, and a mere four (1.3%) which were clinically significant. Laboratory cost to the patients totalled US $15 725, with US $8573 (54.5%) attributed to tests that were not indicated (36). A 1996 study from a USA University hospital that established a pre-anaesthetic clinic and changed the ordering of preoperative tests from surgeons/primary care physicians to anaesthetists, reported a hospital cost-reduction of 59.3% and US $112.09 per patient, which translated to a potential US $1.01 million savings for the hospital in that year (37). A Canadian study demonstrated a reduction in cost of preoperative testing from $124 per patient to $73 when selective ordering of tests by staff anesthesiologists was conducted (38). The introduction of guidelines for preoperative investigations for elective surgery in 2012 at the Queen Elizabeth Hospital in Barbados resulted in savings of US $40 745.50 per year, mainly due to a significant reduction in the number of full blood count and chest X-ray tests that were ordered (39).

Adoption of newer guidelines that eliminate routine testing without clinical indications have resulted in considerable savings, at no increased risk to patients, as well as the prevention of unnecessary delay or cancellation of surgery (38–47), when compared to institutions with none or poor compliance (48–50). Delay or cancellation of surgery can be a significant cause of preoperative anxiety and increase costs. In some patients with false positive results (*ie* abnormal results, though clinically healthy with no underlying medical conditions), the tests were repeated and some underwent further evaluation, which caused further delay of surgery, psychological distress and further economic burden (3, 5, 7, 10). In this current *era* of increased litigation, these matters could result in medico-legal liability. Physicians, however, must be careful to ensure that safety, quality of surgical and anaesthetic care, and excellent postoperative outcomes are not sacrificed for the reduction of cost and waiting time for surgery. Two authors also cautioned about the possibility of false negative tests, which can cause a false sense of security and may result in unfavourable outcome (12, 13). The involvement of appropriate medical personnel, particularly anaesthetic staff aided the development of guidelines, adherence and hence, cost-reduction (37–43).

The current recommendation by developed countries is that indicated tests must be guided by the patient's health condition, invasiveness of planned surgery and potential for blood loss (1–2). This strategy is regarded as appropriate risk management as it involves identification of the patients at risk, optimization of preoperative health status, *ie* risk reduction through medical intervention and other appropriate perioperative care (23, 26). The general consensus is that no investigations are required for healthy patients prior to minor surgery, regardless of age (1, 2, 51).

A healthy patient is one who has no organ/system dysfunction and hence, an American Society of Anesthesiologists [ASA] Physical Health Score of 1 (52–54), [Tables 1, 2]. Minor surgery refers to operation on the superficial structures of the body or a manipulative procedure that does not involve a serious risk to the patient (55). This is classified as Category 1, being a minimally invasive procedure associated with none or minimal blood loss. As with other categories of surgery, this risk is independent of anaesthesia and ASA status (56). Moderate, intermediate or minimal to moderate surgery, Category 2, is expected to have blood loss less than 500 cc, hence, the risk is mild (57). Major surgery includes operation on an organ within the cranium, chest, abdomen, or pelvic cavity and involves a risk to the life of the patient. This type is classified as Category 3 to 5,

based on the extent of invasiveness. Category 3 includes moderately to significantly invasive procedure, with a blood loss potential of 500–1500 cc (57, 58). Categories 4 to 5 include highly invasive procedures with estimated blood loss greater than 1500 cc, with those in Category 5 most likely to require intensive care admission and invasive cardiovascular monitoring (57–58).

Table 1: Investigations for healthy persons schedule to undergo moderate to major surgery electively or emergently.

| Age | Investigations for moderate and major surgery | Timing |
|---|---|---|
| 0 to 50 years | PCV/haemoglobin + Group and X-match: if moderate to severe blood loss is expected<br>LMP +/ Pregnancy test | Within six months IF no change in the patient's clinical status. |
| > 50 years | FBC + Group and X-match, if moderate-to-severe blood loss is expected<br>Random blood glucose/glucometer reading,<br>Urea and electrolytes<br>ECG – if symptomatic or assessed to have irregular pulse or other cardiac sign/s | If there are new symptoms, the tests **MUST** be repeated as appropriate. |

No investigations are required prior to minor surgery for healthy patients
PCV: pack cell volume; LMP: last menstrual period; FBC: full blood count; ECG: electrocardiogram

Table 2: American Society of Anesthesiologists physical status score.

| Score | Physical condition |
|---|---|
| I. | Patient is a completely healthy fit patient. |
| II. | Patient has mild systemic disease. |
| III. | Patient has severe systemic disease that is not incapacitating. |
| IV. | Patient has incapacitating disease that is a constant threat to life. |
| V. | A moribund patient who is not expected to live 24 hours with or without surgery. |

E. denotes emergency surgery, and is placed after the Roman numeral.

If a healthy, ASA I patient is scheduled to undergo major surgery, especially vascular surgery, baseline haemoglobin level, group and cross-match must be done regardless of age. Patients over 50 years may develop illnesses which are not or mildly symptomatic, and hence, a random blood glucose, electrolytes, urea and creatinine are also indicated. Patients with a history of chronic medical illness or newly diagnosed medical problems must undergo tests relevant to their medical disease, current medication/s and the invasiveness and risk of the proposed operative procedure. The latter may be minimal/minor/low-risk, moderate/intermediate, or major/highly invasive/high-risk as discussed above (56–59). The minimum investigations required for common medical problems are listed in Table 3, and these must be done for all categories of surgery (1, 2, 12, 20, 45, 57, 58). Elective surgery may have to be postponed and appropriate treatment instituted if results are abnormal. Examples of the categories of surgical procedures are shown in Table 4, a hybrid of others (1, 2, 57, 58). It is important to note that a normal history and physical examination does not negate complications. A low-risk procedure may result in unexpected damage *eg* to an anomalous vital organ/structure (*eg* blood vessel or nerve) which could not be detected by the history and physical examination or may be due to the surgery being performed by an inexperienced surgeon.

Pre- and intra-operative autologous blood donation, though not a part of the preoperative investigation, is important in the preoperative preparation for surgery, especially in the Jamaican setting where voluntary blood donation does not meet the national need (59). On average, 24 000 units of blood are collected annually by the National Blood Transfusion Service, but approximately 50 000 to 75 000 units are required (59). Preoperative donation can be done for children over seven years and adults up to 75 years (60–63). The decision for persons to donate preoperatively or intra-operatively must be considered in every elective patient undergoing major surgery and done in conjunction with the patient and the doctors caring for these patients.

## CONCLUSION

The guidelines developed for the University Hospital of the West Indies, take into account the available evidence and the most recent guidelines from the United Kingdom (NICE and the British Medical Association), and the United States of America (ASA Task Force). It is hoped that greater emphasis will be placed on a thorough history and physical examination and indicated or diagnostic investigations for the evaluation of fitness for anaesthesia and surgery. Appropriate adherence to the guidelines should result in significant savings that could be diverted to other appropriate areas for improvement in the healthcare system. This is especially important in developing countries like Jamaica, with financial limitations. It will also decrease the psychological stress in patients who have insignificant abnormal results and unnecessary cancellation of surgeries. Major surgeries will require more investigations, as the risk is higher and there is need to document preoperative status for pre- and

Table 3: Investigations to be done for persons with chronic medical diseases scheduled to undergo minor, moderate or major surgery electively.

| Disease condition | Investigations | Timing |
|---|---|---|
| Diabetes mellitus | FBC, Urea and electrolytes | Urea and creatinine within a week if stable, or earlier if not |
| | Fasting and two-hour blood glucose /glucometer | < 24 hours |
| | ECG | Within one month if stable or less if symptomatic |
| | $HbA_{1c}$ | < 3 months |
| Hypertension | Random blood glucose/ glucometer | < 24 hours |
| | Urea and electrolytes | < 6 weeks **IF** no new symptoms or signs<br>Earlier if symptomatic |
| | ECG | ECG < 6 weeks if asymptomatic **OR** stat if experiencing SOB, orthopnoea, PND, CCF, AF etc. |
| | CXR | Repeat if symptomatic as above +/- cough and sputum suggestive of pneumonic process or heart failure |
| Cardiac disease | Random blood glucose/ glucometer | < 24 hours for glucose |
| | Urea and electrolytes | |
| | ECG | |
| | CXR | < 6 weeks **IF** no new symptoms or signs |
| | Cardiac consult/ECHO | Repeat preoperative if symptomatic |
| | ± Stress test | |
| Renal disease | FBC | Blood investigations |
| | Urea, creatinine and electrolytes | < 24–48 hours. |
| | Bleeding indices | (post dialysis if applicable) |
| | ECG | ECG < 6 weeks or earlier if symptomatic |
| Hepatic disease | FBC | |
| | Urea, creatinine and electrolytes | < 24 hours |
| | Liver function tests | |
| | Bleeding indices | |
| Preeclampsia/ eclampsia | FBC | |
| | Urea and electrolytes | < 24 hours |
| | Bleeding indices | |
| | +/ Liver function tests | |
| Coagulopathy/ anticoagulant therapy | FBC | < 24 hours |
| | Bleeding indices | |
| Goitre/ thyroid disease | FBC | < 6 weeks |
| | Urea and electrolytes | or earlier if symptomatic |
| | Thyroid function tests | |
| | Calcium & albumin | |
| | Thoracic inlet views ± MRI | |
| | ECG if previously thyrotoxic | |
| All disease conditions | Group and cross-match if anticipate blood loss > 10 mL/kg | < 1 week<br>**Preoperatively donation** - within one month but not within one week before surgery. |
| | Autologous blood donation – for healthy patients (>12 years) *ie* no cardiac, respiratory or debilitating conditions/diseases,<br>Hb ≥12 g/dL and<br>Normal PT, PTT | **Intra-operatively** - acute normovolaemic haemodilution or blood salvaging.<br>**Consent for latter must be obtained preoperatively** |

PCV: pack cell volume; LMP: last menstrual period; FBC: full blood count; ECG: electrocardiogram; MRI: magnetic resonance imaging; PT: prothrombin time; PTT: partial thromboplastin time; $HbA1_c$: haemoglobin; CXR: chest X-ray; SOB; shortness of breath; PND: paroxysmal nocturnal dyspnoea; CCF: congestive cardiac failure
AF: Atrial fibrillation.
**These recommendations are guidelines only**, and may need to be customized for individual patients depending on their clinical status. If a patient is showing ongoing, worsening or new symptoms or signs, more recent investigations **MUST** be done to determine the severity of her/his current condition.

Table 4: Examples of minor, intermediate and major surgeries.

| Minor/low risk | Intermediate risk | Major/high risk |
|---|---|---|
| Excision of skin lesion | Extensive superficial procedures | Total abdominal hysterectomy |
| Dental restoration | Burn excision/debridement | Laparotomy for gastrectomy, ruptured appendix |
| Draining breast abscess | Tonsillectomy and/or adenoidectomy | Endoscopic resection of prostate |
| Breast lump excision/biopsy | Septoplasty/rhinoplasty | Lumbar discectomy and other spine surgeries |
| Myringotomy tube (Grommet/s) insertion | Carotid endarterectomy | Thyroidectomy/parathyroidectomy |
| Cataract surgery | Appendicetomy (non-ruptured) | Radical neck dissection |
| Lysis of sublingual frenulum | Caesarian section | Total joint replacement |
| Inguinal hernia (nil bowel obstruction/strangulation) | Primary repair of inguinal hernia | Pneumonectomy |
| Circumcision | Umbilical hernia repair | Colonic resection |
| Cystoscopy | Knee arthroscopy | Neuro/cardiac surgery |
| Hysteroscopy | Arthroscopy Inguinal hernia repair | Major vascular surgery |
| Vasectomy | Open reduction of fracture | Nephrectomy |
| Fiberoptic bronchoscopy | Excising varicose veins in the leg | Major laparoscopic procedures |
| Transoesaphgeal echocardiography | Laparoscopic lysis of adhesions | Open thoracic or intracranial procedure |
| Closed reduction of fracture | Diagnostic laparoscopy | Major procedure on the oropharynx |
| | Dilation and curettage | Major vascular, skeletal, neurologic repair |
| | Fallopian tubal ligation | |

postoperative comparison as well as for medico-legal accountability. As suggested by the United Kingdom, "*When exercising their judgment, professionals and practitioners are expected to take this guideline fully into account, alongside the individual needs, preferences and values of their patients or the people using their service. The guideline does not override the responsibility to make decisions appropriate to the circumstances of the individual, in consultation with them and their families and/ or guardian*".

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