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ORIGINAL ARTICLE

# Assessing adherence to pre-operative spirometry testing guidelines among medical doctors in Malta

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**Background:** Pulmonary complications arising from surgical procedures are frequently encountered in the clinical setting, resulting in high levels of patient morbidity and mortality. It is important to assess the risk of developing these complications during the pre-operative assessment. Spirometry is a simple and non-invasive means of evaluating pulmonary function, yet it should not be utilised unnecessarily.

**Aims:** To assess whether pre-operative spirometry requests at Mater Dei Hospital, Malta are indicated.

**Methods:** A retrospective analysis of all pre-operative spirometry requests and tests during September 2022 at the Pulmonary Function Lab at Mater Dei Hospital was performed. Patient characteristics were noted from the pre-operative assessment note. The local guideline entitled 'pre-operative generic investigations for adult elective surgery' was used as the gold standard to determine whether the spirometry request was indicated.

**Results:** A total of 156 patients had pre-operative spirometry performed in September 2022. Pre-operative spirometry testing was not indicated in 63.5% (n= 99). Patients in whom spirometry was indicated, 54.3% (n=31) had an American Society of Anaesthesiologists (ASA) classification of 3 or above, 29.8% (n=17) were unable to climb two flights of stairs, and 15.8% (n=9) had both indications.

**Conclusion:** Routine ordering of spirometry is discouraged in the pre-operative period. Instead, pre-operative spirometry should be requested if the patient is classified as an ASA of 3 or above, or if they cannot manage to climb two flights of stairs. Taking a careful approach to choosing which patients undergo pre-operative spirometry could result in reduced costs and shorter waiting times.

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Every year, around 230 million patients worldwide undergo surgical procedures. Current literature shows that hospital mortality rates for such surgical procedures range from 1% to 4%.[1] It is important to recognise that post-operative complications can significantly impact patient outcomes, leading to increased mortality, morbidity and longer hospitalisation stays.

Pulmonary complications can be stratified based on their potential for mortality. They fall into two main categories: major complications like respiratory failure, prolonged mechanical ventilation, or intubation exceeding 48 hours and minor complications like tracheobronchitis, atelectasis, and bronchospasm. It is encouraged to assess pulmonary risks before surgery as it enables the medical professional to implement preventive measures. By doing so, they can effectively reduce the incidence of these complications, ultimately improving patient outcomes and minimising both morbidity and hospitalisation stays.

Spirometry is a non-invasive tool for assessing pulmonary function.[3] It measures the forced expiratory volume in 1 second ($FEV_1$) and forced vital capacity (FVC), and identifies normal, obstructive, or restrictive ventilatory patterns. These ventilatory impairments (obstructive or restrictive) are associated with underlying medical conditions such as chronic obstructive pulmonary disease (COPD), asthma, or interstitial lung disease.[4] Consequently, pre-operative spirometry findings are leveraged to forecast the likelihood of postoperative pulmonary complications, particularly among individuals undergoing thoracic surgery.[5] Nevertheless, its predictive value for patients undergoing non-thoracic surgeries is not clear.

The American College of Physicians published its first clinical guidelines in 2006 for assessing risks to prevent post-operative pulmonary complications in patients undergoing non-cardiothoracic surgeries.[6] These guidelines prioritise a clinical evaluation to identify risk factors associated with the patients' health and the specific surgical procedure. One important aspect of these guidelines is their recommendation against the routine use of pre-operative spirometry. This recommendation was based on the observation that the available evidence did not conclusively demonstrate the superiority of pulmonary function testing over a comprehensive assessment of the patient's medical history and a physical examination in predicting which patients were at risk of experiencing post-operative pulmonary complications. These guidelines were developed based on a thorough review of the existing literature. However, they failed to establish a strong relationship between pre-operative pulmonary function test results and the probability of experiencing post-operative pulmonary complications.[7,8]

In contrast, subsequent studies have suggested a relationship between pre-operative pulmonary function test results and the likelihood of post-operative pulmonary complications in individuals having abdominal surgery.[9-14]

## AIMS

The aim of the audit was to determine whether pre-operative spirometry requests at Mater Dei Hospital are indicated.

## METHODS

### *Participants and Study Procedures*

The audit consisted of a retrospective analysis of data obtained from 156 patients who had undergone spirometry testing in the period from September 1st to September 30th 2022, at Mater Dei Hospital's Pulmonary Function Lab. The data collection process involved gathering all the spirometry test referrals made by junior doctors at the Pre-operative Assessment Clinic (POAC) for patients scheduled to undergo elective surgical procedures. During a pre-operative visit, the junior doctor needs to conduct history taking and physical examination for each patient before answering several questions that tackle the cardiovascular, respiratory, gastrointestinal, renal, and endocrine systems.

To access patient records, iSOFT Clinical Manager® and Patient Dashboard ® were used. The latter provides access to both POAC clinical notes and spirometry results. Eligible participants were scheduled to undergo a range of elective surgical procedures under general anaesthesia. The following surgical procedures were included: thoracic, upper

and lower abdominal, orthopaedic, gynaecological and Ear, Nose, and Throat (ENT) surgeries. If a patient underwent more than one surgery during this time period, only their initial surgery was included.

The gold standard used was the 'pre-operative, generic investigations for adult elective surgery' guideline established by the Department of Anaesthesia at Mater Dei Hospital. According to this guideline, patients should be referred for spirometry only if they report an inability to climb two flights of stairs, in which case this warrants further discussion with the Perioperative Assessment Clinic (POAC) consultant anaesthetist. Additionally, if any indications of severe systemic disease (ASA 3 or above) are detected during clinical evaluation, lung function testing should be requested.

Within the pre-operative spirometry assessments, Forced Expiratory Volume in 1 second (FEV1), Forced Vital Capacity (FVC) and the ratio of $FEV_1$ to FVC ($FEV_1$/FVC)) were measured. Spirometry assessments were conducted by a specialist nurse at the Pulmonary Function Lab. These tests were carried out within 3 months leading to the surgical procedure. The pulmonary function parameters were carefully recorded and patients were categorised through spirometry into a 'normal', 'obstructive', or 'restrictive' group.

Patient demographics were also collected. These included: age, gender, smoking, underlying medical conditions, and type of surgery to be performed. Grades of the complexity of surgery (including major, intermediate, and minor) were collected according to the NICE surgical categorisation guidelines. The American Society of Anaesthesiologists (ASA) physical status classification system was used. Smoking history was classified into three categories: current smoker, ex-smoker, and non-smoker.

### *Clinical Outcomes*

The focus of the audit was to determine whether junior doctors adhere to the 'pre-operative, generic investigations for adult elective surgery' guideline by appropriately referring patients scheduled for elective surgery to undergo pre-operative spirometry testing.

## RESULTS

A total of 162 patients underwent spirometry after POYC referral during the 30-day study period. Out of these patients, 6 patients did not have any data on pre-operative spirometry result and hence were excluded. The final analysis included 156 patients. The mean age was 58 years (Table 1). The cohort was made up of 81 males (51.9%) and 75 females (48.1%). Eligible participants were scheduled to undergo a range of elective surgical procedures which were categorised into major (n=52, 33.3%), intermediate (n=50, 32.1%) and minor (n=54, 34.6%) according to the NICE classification (Figure 1).

As per the 'pre-operative generic investigations for adult elective surgery' guideline, spirometry testing was deemed unnecessary in 63.5% (n= 99) of patients

**Table 1** *Baseline Characteristics of patients*

| Demographics | Number (%) |
|---|---|
| **Age, years** | |
| Average Age | 58 |
| <20 | 4 (3%) |
| 20-40 | 20 (13%) |
| 40-60 | 48 (31%) |
| 60-80 | 82 (53%) |
| >80 | 2 (1%) |
| **Sex** | |
| Male | 81 (51.9%) |
| Female | 75 (48.1%) |
| **Smoking History** | |
| Smoker | 65 (41.7%) |
| Non Smoker | 77 (49.4%) |
| Ex-Smoker | 14 (9.0%) |
| **Type of Surgery** | |
| Major | 52 (33.33%) |
| Intermediate | 50 (32.1%) |
| Minor | 54 (34.6%) |

(Figure 2). The main reasons why spirometry was indicated in the remaining 36.5% of the study cohort were: ASA 3 or above (n=31, 54.3%), unable to climb two flights of stairs (n=17, 29.8%) or both (n=9, 15.8%) (Figure 3).

In the cohort of patients for whom spirometry testing was indicated, the results show a range of spirometry patterns. Specifically, we observed that 18 patients exhibited a normal spirometry pattern, while three had an obstructive pattern and 36 had a restrictive pattern. These findings suggest a diverse spectrum of pulmonary conditions within this subgroup of patients. Among the patients who had spirometry indicated, nine patients had asthma, 10 patients had chronic obstructive pulmonary disease (COPD), and three had obstructive sleep apnea (OSA).

In contrast, among the patients for whom spirometry was not indicated, a different set of spirometry patterns were identified. A total of 60 patients in this group showed a normal spirometry pattern. However, in this cohort, 37 patients had a restrictive spirometry pattern, and two had an obstructive pattern. While the patient cohort exhibited comorbidity, the focus was primarily on respiratory conditions. Furthermore, within the cohort where spirometry was not indicated, 37 patients had asthma and two patients had OSA. There were no COPD patients in this cohort.

Throughout the combined restrictive spirometry pattern cohort (n=75), two people were known to suffer from Interstitial Lung Disease (ILD) beforehand. The cohort's forced expiratory time (FET) was subsequently assessed. The results show that 15% (n=11) of the patients with a restrictive spirometry had an FET greater than 6 seconds (Table 2).

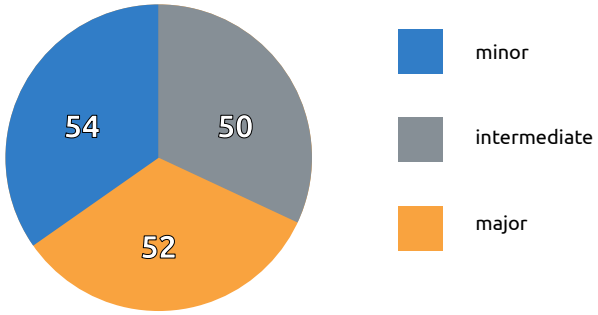


**Figure 1** *Distribution of surgical procedures according to NICE Surgical Categorisation*

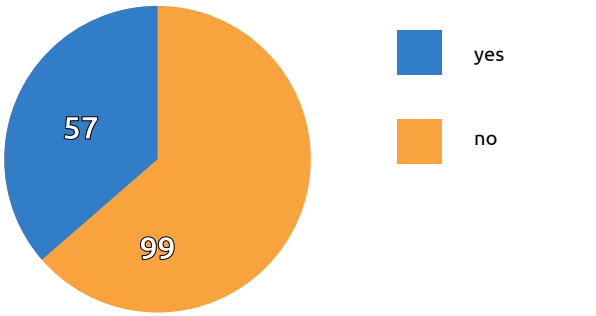


**Figure 2** *Indication of spirometry testing in our patient cohort*

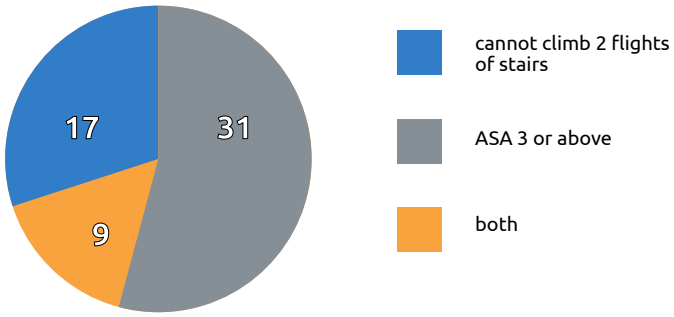


**Figure 3** *Pie chart depicting the indication for spirometry*

**Table 2** *Combined Summary of Spirometry Results, Respiratory Conditions, and FET*

| Category | Subcategory | Spirometry Indicated | Spirometry NOT Indicated | Total |
|---|---|---|---|---|
| Spirometry Results | Normal | 18 | 60 | 78 |
| | Obstructive | 3 | 2 | 5 |
| | Restrictive | 36 | 37 | 73 |
| Restrictive (FET Analysis) | FET >6sec | - | - | 11(15%) |
| | FET <6sec | - | - | 62(86%) |
| Respiratory Conditions | Asthma | 9 | 37 | 46 |
| | COPD | 10 | 0 | 10 |
| | OSA | 3 | 2 | 5 |

## DISCUSSION

The audit on adherence to the 'pre-operative, generic investigations for adult elective surgery' guideline showed that a significant portion of the cohort studied did not undergo spirometry testing as per current local guidelines. Among the cohort for whom spirometry was indicated, the primary reasons included patients with an ASA classification of 3 or above, emphasizing a more comprehensive assessment for higher-risk individuals. Additionally, a significant portion of patients were indicated for spirometry due to their functional limitations, precisely an inability to climb two flights of stairs. However, it is important to note that junior doctors also referred patients for spirometry testing if they smoked or had an ASA of 1 or 2, which was not according to guidelines.

The potential overuse of pre-operative spirometry testing may be attributed to an absence of awareness among junior doctors about the existence and access to local guidelines. If physicians are not aware that these guidelines exist, there could be a tendency to default to a technique of examining all individuals preoperatively. One possible contributing element could be the absence of educational initiatives or lectures specifically aimed at addressing these guidelines.

A multifaceted approach is necessary to resolve these inappropriate investigation referrals. Executing curricula, for instance, by providing lectures, can enhance the understanding of pre-operative testing among junior physicians. Stressing the importance of critical thinking in applying such guidelines, encouraging continuous education, and promoting a culture of continuous learning can contribute to a more judicious use of guidelines and promote evidence-based decision-making.

The analysis of spirometry patterns among patients for whom testing was not initially indicated revealed a distinct set of results. It is important to note that 37 patients had a restrictive spirometry pattern despite spirometry not being deemed necessary according to guidelines.

The observation of a significant number of patients with restrictive patterns raises concerns about the accuracy of our spirometry test results. Assessment of these patients' FET showed that a large majority (85%) had an FET less than the recommended 6 seconds. This could be explained by potentially incorrect patient technique and compliance, leading to a large amount of false positive restrictive results. None of the patients in the cohort had their results confirmed via referral for plethysmography. The discrepancy between the number of patients with an obstructive pattern and COPD patients can be further explained by, either patients having emphysema without an obstructive pattern on spirometry or, patients having been diagnosed as COPD and started on treatment prior to spirometry being performed.

Overusing pre-operative spirometry testing will affect health care services, overall effectiveness, and patient experience. First, this method can negatively influence healthcare services by contributing to longer waiting times. Unnecessary spirometry testing for people not satisfying guideline criteria can also result in ineffective resource appropriation. Additionally, the excess costs associated with conducting and interpreting unwarranted tests divert resources that could be utilized elsewhere within the health care system. Moreover, patients subjected to

### SUMMARY BOX

- The audit on adherence to the 'pre-operative investigations for elective surgery' guideline found out that a significant portion of the cohort studied did not undergo spirometry testing as per local guidelines.
- Before elective surgery, adults should have pre-operative spirometry testing only if they cannot climb two flights of stairs, have an ASA of 3 or above, or if there are suspicions of significant cardiopulmonary comorbidity. It is crucial to consult with the POAC consultant prior to requesting the test.
- The possible excessive use of pre-operative spirometry testing could result from junior physicians lacking awareness of the current local guidelines and their accessibility.
- Implementing targeted educational programs for junior physicians can enhance awareness and understanding of such guidelines.

unnecessary testing might experience increased stress, anxiety and longer waiting times.

The limitations of this audit are the following. The short duration of the audit may have influenced the ability to capture longitudinal variations over a prolonged period. The lack of information on patients who were not referred for spirometry testing restricts the understanding of the entire population. Future audits should consider longer timelines and include data on the whole population for more accurate findings.

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