

Quality Indicators Report  
for guideline  
**Thyroid cancer:  
assessment and management**

Health Insurance Organisation

September 2026



## 1. Introductory note

The United Kingdom (UK) National Institute for Health and Care Excellence (NICE) guideline NG230 “Thyroid cancer: assessment and management” was developed in 2022. The updated version of the guideline was made available to the Health Insurance Organization (HIO) in Cyprus through a license agreement with NICE, towards the contextualization of the guideline to the Cyprus healthcare system framework. To this end, HIO recruited local medical experts in the field of thyroid cancer, other relevant healthcare professionals, and patient representatives, and formed a Technical Expert Committee (TEC). The TEC was supported by the Guidelines Scientific Secretariat who managed the guideline process along with HIO and provided support in committee recruitment, methodological issues, stakeholder consultation and guideline publication and dissemination. In a series of meetings and following a public consultation procedure, the TEC members assessed the scope and the full text of the guideline, and implemented modifications, if these were well supported by scientific evidence. In addition, the TEC members examined the quality indicators relating to the assessment and management of thyroid cancer that have been developed by NICE for the UK National Health Service (NHS), in terms of their applicability for the Cyprus General Health System (GESY). Those that were deemed both clinically relevant and technically feasible were selected for implementation. In total, four indicators were suggested by the TEC for implementation in the GESY and are listed below, while a full description is available in Appendix I.

**Table 1:** Quality indicators for the contextualized “Thyroid cancer: assessment and management” guideline.

| Indicator | Indicator description                                                                                                                                                                                                                  |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>A</b>  | The percentage of patients who have undergone surgery for thyroid cancer within the previous 12 to 24 months and have been diagnosed with permanent postoperative vocal cord paralysis.                                                |
| <b>B</b>  | The percentage of patients who have undergone surgery for thyroid cancer between 12-24 months prior to the indicator assessment and have been diagnosed with permanent postoperative hypoparathyroidism within the previous 12 months. |
| <b>C</b>  | The percentage of patients who underwent surgery for thyroid cancer within the previous 12-24 months and were evaluated for permanent postoperative vocal cord paralysis six months or more after the date of surgery.                 |

|          |                                                                                                                                                                                                                                      |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>D</b> | The percentage of patients who underwent surgery for thyroid cancer between 12-24 months prior to the indicator assessment and have been evaluated for postoperative hypoparathyroidism 12 months or more after the date of surgery. |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## 2. Methods

### 2.1 Estimation of quality indicators

Following the selection of the quality indicators, HIO officers, including information technology (IT) personnel, with the support of an external support committee (Secretariat), ran several tests to finalize the indicator business rules (calculation algorithms), indicator data sources, and collected variables (variable codes) from the HIO data system. Where appropriate for several diagnoses, both in-hospital and outpatient data sources and variable codes were included. Appendix II describes the business rules while the full list of diagnoses included in the calculation of Quality Indicators is presented in Appendix III.

To assess the implementation of the contextualized NICE guideline NG230 and monitor improvement, quality indicators are estimated on a year-to-year basis. To this effect, this report provides initial insights into implementation and quality of care improvement by carrying out comparisons between a baseline and a reporting period for all indicators. The baseline period corresponds to the last year prior to the implementation of the contextualized guideline within the framework of GESY (01/11/2023 - 31/10/2024) while the reporting period corresponds to the first year of guideline implementation (01/11/2024 - 31/10/2025). Furthermore, this report aims to put in context the indicators' output, by providing an overview of the relevant scientific literature on the subject and similar indicator output or metrics from other healthcare systems across the world in the form of a short narrative literature review. Finally, this report aims to provide suggestions to HIO for further improvement of quality of care in the area addressed by the examined indicators.

### 2.2 Synthesis and statistical comparisons

The output of indicators is presented as counts and percentages and is visualized in the form of bar charts across the two periods. Comparison between the baseline and reporting period has been carried out using the Pearson's Chi-squared test for categorical variables while statistical significance has been set at  $p < 0.05$ . All graphs were generated using Microsoft Excel.

### 2.3 Narrative literature review

The electronic databases PubMed and Google Scholar were searched from January 2000 until October 2025 using appropriate search terms to identify studies or published reports providing information relating to the indicators. Studies were considered relevant if they provided the same indicator metrics or enough data in the form of numerator/denominator to calculate the corresponding indicator metrics. As Indicators A and C focused on assessment and diagnosis of vocal cord paralysis after surgery for thyroid cancer and Indicators B and D focused on assessment and diagnosis of hypoparathyroidism after surgery for thyroid cancer, two literature searches were carried out, one combined for indicators A and C and one combined for B and D. Examples of combinations of search terms used for the selection of relevant studies for each indicator are provided in Table 2. Boolean operators “AND”, “OR” were used to structure search algorithms.

**Table 2:** Narrative review literature search terms.

| Indicator                  | Search terms                                                                                                                                                                                                                                                                                        |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Indicator A &amp; C</b> | (“Thyroid cancer” OR “Thyroid surgery” OR “Thyroid cancer surgery”) AND (“complications” OR “RLN nerve risk” OR “vocal cord paralysis” OR “vocal cord palsy”) AND (“epidemiology” OR “etiology” OR “population based” OR “national”)                                                                |
| <b>Indicator B &amp; D</b> | (“Thyroid cancer” OR “Thyroid surgery” OR “Thyroid cancer surgery”) AND (“hypoparathyroidism” OR “persistent hypoparathyroidism” OR “permanent hypoparathyroidism” OR “complications” OR “postoperative hypoparathyroidism”) AND (“epidemiology” OR “etiology” OR “population based” OR “national”) |

### 3. Results

Indicator output for the baseline and reporting periods was provided by HIO in November 2025 and the Secretariat analyzed the data and reviewed the relevant literature in November and December 2025. The Final Report was submitted to HIO in July 2026. The output for indicators A, B, C, and D is provided in Table 3 below and summarized in Figures 1, 2, 3, and 4, respectively.

In summary, the overall percentage of patients who underwent surgery for thyroid cancer and were evaluated for permanent postoperative vocal cord paralysis was low ( $\approx 11\%$ ) and largely unchanged between the two periods (indicator C:  $\chi^2 = 0.0003$ ,  $p = 0.987$ ). Similarly, the percentage of patients who underwent surgery for thyroid cancer and had been evaluated for postoperative hypoparathyroidism was also low in both periods with a non-significant ( $\chi^2 = 0.913$ ,  $p = 0.339$ ) decrease between the baseline (24.29%) and the reporting period (21.57%).

In terms of the fraction of patients that have undergone thyroid cancer surgery and have been diagnosed with permanent postoperative vocal cord paralysis, the value of indicator A was low and also remained largely unchanged between the two periods (1.80% in the baseline period to 2.20% in the reporting period) with this slight difference not being statistically significant (indicator A:  $\chi^2 = 0.182$ ,  $p = 0.670$ ). Nevertheless, the fraction of patients that have undergone thyroid cancer surgery and have been diagnosed with permanent postoperative hypoparathyroidism, improved between the baseline and reporting period. In more detail, during the baseline period, 3.1% of patients that have undergone thyroid cancer surgery were diagnosed with postoperative hypoparathyroidism, as opposed to just 0.6% during the reporting period and this reduction in postoperative hypoparathyroidism risk was statistically significant ( $\chi^2 = 8.110$ ,  $p = 0.0044$ ).

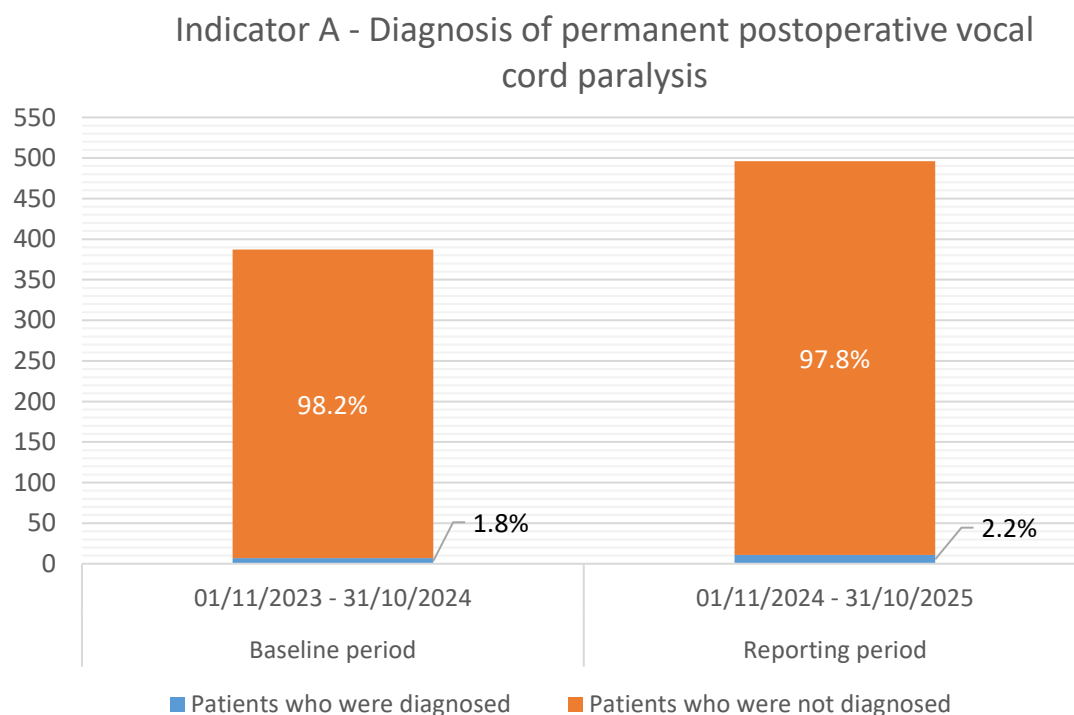
**Table 3:** Indicator output for indicators A, B, C and D.

| Indicator | Short description                                                                                                                                                                                       | Indicator value<br>(Baseline period:<br>01/11/2023 - 31/10/2024) |       | Indicator value<br>(Reporting period:<br>01/11/2024-31/10/2025) |       | Difference     |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|-------|-----------------------------------------------------------------|-------|----------------|
| A         | The percentage of patients who have undergone surgery for thyroid cancer within the previous 12 to 24 months and have been diagnosed with permanent postoperative vocal cord paralysis.                 | Numerator: 7                                                     | 1.81% | Numerator: 11                                                   | 2.22% | +0.41%         |
|           |                                                                                                                                                                                                         | Denominator: 387                                                 |       | Denominator: 496                                                |       |                |
| B         | The percentage of patients who have undergone surgery for thyroid cancer between 12-24 months prior to the indicator assessment and have been diagnosed with permanent postoperative hypoparathyroidism | Numerator: 12                                                    | 3.1%  | Numerator: 3                                                    | 0.60% | <b>-2.50%*</b> |
|           |                                                                                                                                                                                                         | Denominator: 387                                                 |       | Denominator: 496                                                |       |                |

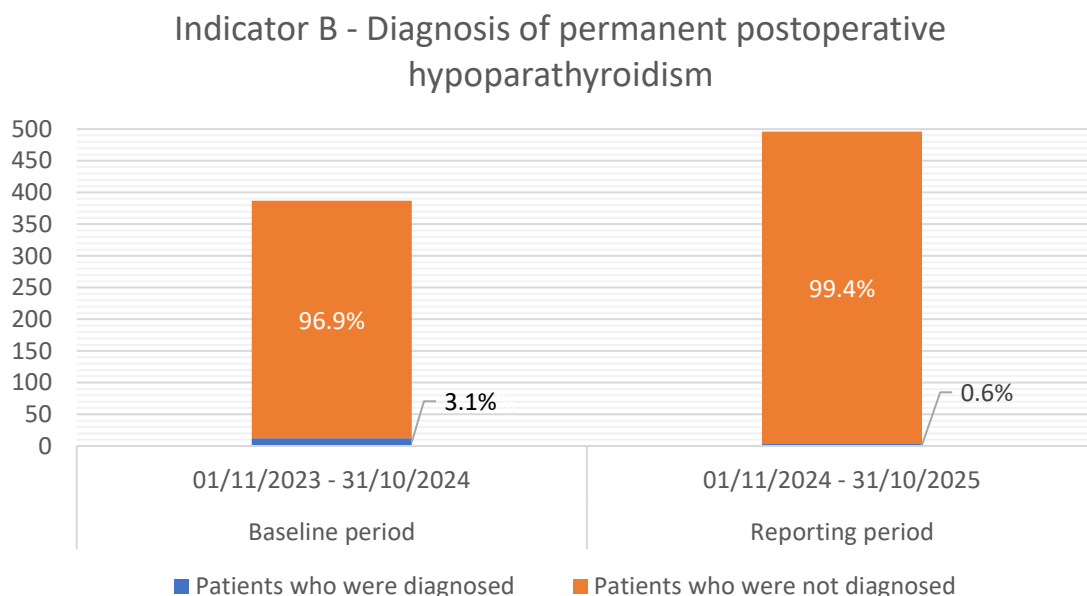
|   |                                                                                                                                                                                                                                      |                  |        |                  |        |        |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--------|------------------|--------|--------|
|   | within the previous 12 months.                                                                                                                                                                                                       |                  |        |                  |        |        |
| C | The percentage of patients who underwent surgery for thyroid cancer within the previous 12-24 months and were evaluated for permanent postoperative vocal cord paralysis six months or more after the date of surgery.               | Numerator: 42    | 10.85% | Numerator: 54    | 10.89% | +0.04% |
|   |                                                                                                                                                                                                                                      | Denominator: 387 |        | Denominator: 496 |        |        |
| D | The percentage of patients who underwent surgery for thyroid cancer between 12-24 months prior to the indicator assessment and have been evaluated for postoperative hypoparathyroidism 12 months or more after the date of surgery. | Numerator: 94    | 24.29% | Numerator: 107   | 21.57% | -2.72% |
|   |                                                                                                                                                                                                                                      | Denominator: 387 |        | Denominator: 496 |        |        |

\*Significant at  $p < 0.05$  level

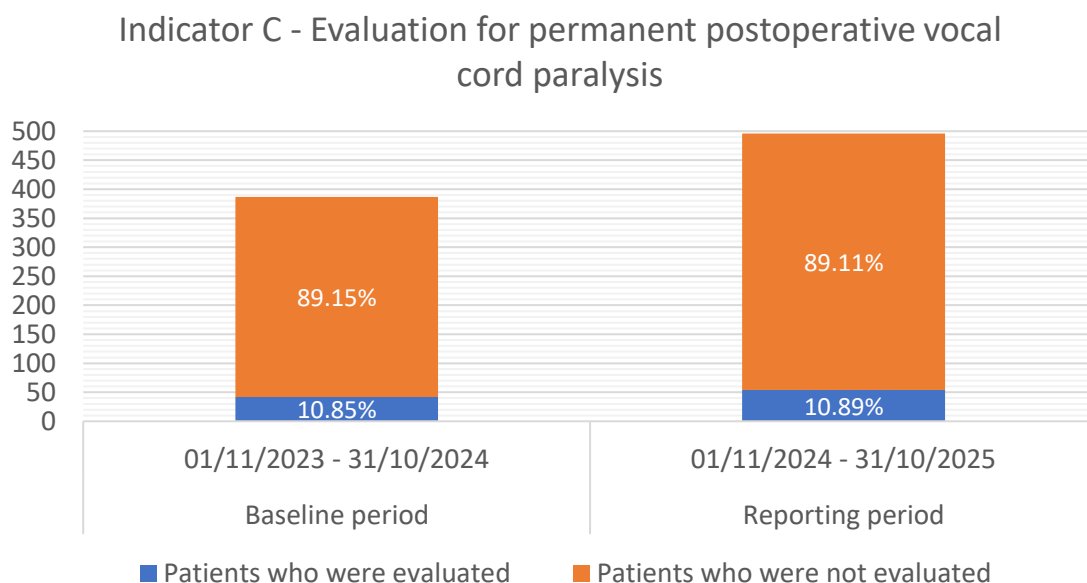
**Figure 1:** Indicator A output for the percentage of patients who have undergone surgery for thyroid cancer within the previous 12 to 24 months and have been **diagnosed with permanent postoperative vocal cord paralysis**, for the baseline and reporting periods.



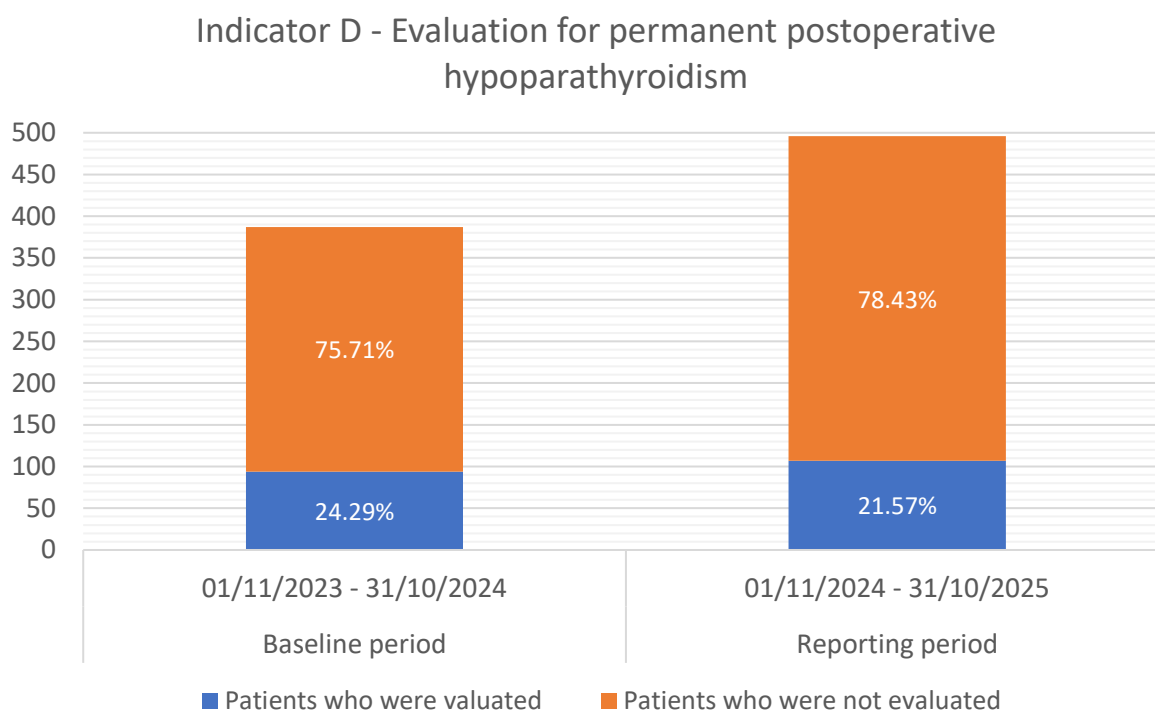
**Figure 2:** Indicator B output for the percentage of patients who have undergone surgery for thyroid cancer between 12-24 months prior to the indicator assessment and have been **diagnosed with permanent postoperative hypoparathyroidism** within the previous 12 months, for the baseline and reporting periods.



**Figure 3:** Indicator C output for the percentage of patients who underwent surgery for thyroid cancer within the previous 12-24 months and were **evaluated for permanent postoperative vocal cord paralysis** six months or more after the date of surgery, for the baseline and reporting periods.



**Figure 4:** Indicator D for the percentage of patients who underwent surgery for thyroid cancer between 12-24 months prior to the indicator assessment and have been **evaluated for permanent postoperative hypoparathyroidism** 12 months or more, after the date of surgery, for the baseline and reporting periods.



## 4. Narrative review

### 4.1 Synthesis of findings for indicator A and C:

**Indicator A:** The percentage of patients who have undergone surgery for thyroid cancer within the previous 12 to 24 months and have been diagnosed with permanent postoperative vocal cord paralysis.

**Indicator C:** The percentage of patients who underwent surgery for thyroid cancer within the previous 12–24 months and were evaluated for permanent postoperative vocal cord paralysis six months or more after the date of surgery.

One of the major complications of thyroid cancer surgery is vocal cord paralysis. This condition arises when the larynx loses its nerve supply, leading to a loss of control over the vocal folds. The main symptoms include breathy quality of the voice, hoarseness, loss of vocal pitch and choking

while swallowing. These symptoms can substantially diminish patients' vocal function and overall quality of life (1,2). According to numerous articles, thyroid surgery is the most common iatrogenic cause of recurrent laryngeal nerve (RLN) injury and thus vocal cord paralysis (3-6), while thyroid cancer is a major risk factor for RLN paralysis due to extrathyroidal invasion and lymph node dissection (7-9).

The narrative review identified several scientific articles based on several nationwide multicenter databases, which reported permanent vocal cord paralysis risk following thyroid surgeries ranging from 0.76% to 4.12%. Malignant disease was a risk factor for post-operative permanent vocal cord paralysis, especially in combination with lymph node resection. Furthermore, there was evidence that intraoperative nerve monitoring as well as higher thyroid surgery volume were protective. The main characteristics and findings from some example studies from literature are summarized in Table 4.

**Table 4:** Studies and reports for permanent postoperative vocal cord paralysis.

| # | Author                                           | Country       | Time Period | Sample type                     | Sample size (n with cancer) | Proportion of Permanent Vocal Cord Paralysis |
|---|--------------------------------------------------|---------------|-------------|---------------------------------|-----------------------------|----------------------------------------------|
| 1 | <a href="#">Rosato L. et al. (2004)</a>          | Italy         | 1995 - 2000 | Multicenter cohort study        | 14934 (1911)                | 2 - 3% **                                    |
| 2 | <a href="#">Dralle H. et al. (2004)</a>          | Germany       | 1998 - 2001 | Multicenter cohort study        | 16448 (1957)                | 3.0% *†                                      |
| 3 | <a href="#">Schneider M. et al. (2019)</a>       | Austria       | 2012 - 2016 | Specialized center cohort study | 4707 (641)                  | 0.76%                                        |
| 4 | <a href="#">Van Dijk D. et al. (2020)</a>        | Netherlands   | 1989 - 2009 | National database               | 567 (567)                   | 3.6% *†                                      |
| 5 | <a href="#">Dilshad M., Baderkhan A. (2023)</a>  | Iraq          | 2018 - 2021 | Multicenter cohort study        | 574 (382)                   | 1.50%                                        |
| 6 | <a href="#">Al Hakami H., Al Garni M. (2024)</a> | Saudi Arabia  | 2015 - 2019 | Specialized center cohort study | 1368 (882)                  | 1.2%*                                        |
| 7 | <a href="#">Papaleontiou M. et al. (2017)</a>    | United States | 1998 - 2011 | National database               | 27,912                      | 4.12%†                                       |

† Risk calculated based only on thyroid cancer patients

\*Converted from per nerve-at-risk to per patient (assuming two nerves per patient or per surgical side)

\*\* varies across different types of thyroid cancer

Overall, across several studies from different countries across the world, the risk for permanent vocal cord paralysis after thyroid surgery generally ranges from 1-3% per patient, with evidence of lower risk reported in high-volume centers. This is in line with a systematic review and meta-analysis that estimated that the incidence of permanent vocal cord paralysis after thyroidectomy is 2.3% (10). However, several of the studies included in that review were single center studies with small sample sizes while in most studies the samples included both patients undergoing surgery for benign and malignant thyroid abnormalities. Focusing on large or multicenter studies, Rosato et al. (11) conducted a large multicenter study in Italy and retrospectively analyzed data collected between 1995 and 2000 from multiple endocrine surgery units. The study included a total of 14,934 thyroid surgery patients, of whom 1,911 had malignant disease. The overall incidence of permanent vocal cord paralysis was 1% among all patients, while the risk was notably higher among those with thyroid cancer, ranging between 2% and 3%, depending on the type of cancer. A larger, prospective study in Germany (8), involving 63 hospitals in Germany with a total of 16,448 thyroid surgeries, including 1,957 procedures for malignant disease was identified. The study specifically assessed the incidence and risk factors of RLN injury, using intraoperative nerve monitoring (IONM) to optimize surgical outcomes. The risk of permanent vocal cord paralysis per nerve was reported at 1.52%, which by assuming two nerves are at risk per patient, corresponds to a risk of permanent vocal cord paralysis of approximately 3%. In the same study, patients undergoing thyroid surgery with lymph node dissection had more than twice the risk of permanent vocal cord paralysis. More recently, in a population-based retrospective study conducted by Van Dijk et al. (12) in the northern region of the Netherlands, covering the years 1989 to 2009, 567 patients were evaluated and a 1.8% prevalence of permanent vocal cord paralysis per nerve was reported. Assuming two nerves at risk per patient, this corresponds to approximately 3.6% per patient.

Nevertheless, there was evidence that the risk of RLN injury was even lower in high-volume centers, suggesting that surgical experience may mitigate the increased risk for this adverse outcome, often associated with thyroid malignancy. For example, Schneider et al. (13) analyzed 4,707 patients treated at a single high-volume thyroid surgery center in Austria between 2012-2016, including 641 patients (14.85%) with malignant thyroid disease. The overall risk of permanent vocal cord paralysis was 0.76%, and when analyzed per nerve, there was no significant difference between malignant and benign cases. Findings were similar in other, non-European settings, with lower risks observed in specialized cancer surgical hospitals. The study

of Dilshad et al. (14) conducted in Iraq involving 574 patients undergoing thyroid surgery in teaching hospitals, of whom the majority (382, 66%) had malignant thyroid disease, found that the overall risk of permanent vocal cord paralysis was 1.5%. Nevertheless, the study did not differentiate outcomes between patients with or without malignant disease. In a similar setting, Al Hakami et al. (15) evaluated 1,368 patients treated at the National Guard Hospital in Saudi Arabia, of whom 882 (64.5%) had malignant thyroid disease. The study reported a risk of permanent vocal cord paralysis of 0.7% per nerve, which corresponds to approximately 1.1% per patient, considering that out of 1368 patients, 809 had bilateral surgery and 559 unilateral. Other studies with smaller sample sizes were in line with these findings (16-18). Finally, a large Medicare study from the United States (US) provided slightly higher estimates regarding overall risk of permanent vocal cord paralysis after thyroid cancer surgery at 4.12%.

The results of this review showed that older adults and patients with comorbid conditions are a vulnerable population and need special consideration, particularly regarding perioperative and postoperative care. In terms of permanent vocal cord paralysis, the risk among thyroid cancer patients aged <65 years old was only 1.4% as opposed to those aged >65 years old, where the risk was 7.1% (19).

Despite notable limitations in the reviewed evidence, including heterogeneity in patient populations, variation in surgical techniques, and differences in how permanent vocal cord paralysis was assessed, the findings consistently indicate that permanent vocal cord paralysis occurs in roughly 1% of patients undergoing thyroid surgery. This risk appears higher, typically around 2-3%, among patients with thyroid malignancy. In Cyprus, for Indicator A, the percentage of patients who have undergone surgery for thyroid cancer within the previous 12 to 24 months and have been diagnosed with permanent postoperative vocal cord paralysis was estimated at 1.8% in the baseline period and reached 2.2% in the following year after the introduction of the guideline. These estimates are comparable to corresponding estimates in other countries. However, it is highlighted that only 10.85% at baseline and 10.89% following guideline introduction were actually assessed for permanent vocal cord paralysis, highlighting the risk of selective assessment in symptomatic patients. Given that a significant percentage of patients can be asymptomatic postoperatively, and vocal cord dysfunction in patients cannot be excluded, it is possible that the estimate of Indicator A is underestimated. Additional efforts to increase diagnostic assessment for permanent postoperative vocal cord paralysis are needed. Lastly, it is noted that no studies were found that specifically aimed to estimate the percentage

of patients assessed for permanent vocal cord paralysis following thyroid surgery and as such no comparisons were made with other countries.

#### **4.2 Synthesis of findings for indicators B and D:**

**Indicator B:** *The percentage of patients who have undergone surgery for thyroid cancer between 12–24 months prior to the indicator assessment and have been diagnosed with permanent postoperative hypoparathyroidism within the previous 12 months.*

**Indicator D:** *The percentage of patients who underwent surgery for thyroid cancer between 12–24 months prior to the indicator assessment and have been evaluated for postoperative hypoparathyroidism 12 months or more after the date of surgery.*

Permanent hypoparathyroidism is also another important complication of thyroid cancer surgery. It can be defined as an undetectable or inappropriately low postoperative parathyroid hormone (PTH) level in the context of hypocalcemia with or without hypocalcemic symptoms (20). In line with the contextualized guideline, permanent hypoparathyroidism was defined as hypoparathyroidism persisting for at least 12 months. Usually, damage to three or more parathyroid glands causes hypoparathyroid effects (21), and the PTH serum threshold for detecting hypoparathyroidism was found to be PTH levels below 10-15 pg/mL, with high sensitivity and specificity (20). Hypoparathyroidism can be caused by inadvertent removal, damage, or devascularization of the parathyroid glands (21). As parathyroid glands greatly contribute to the homeostasis of calcium and phosphorus concentration and the metabolism of vitamin D, chronic hypoparathyroidism results in hypocalcemia and vitamin D deficiency. Therefore, early laboratory detection is feasible through measuring the decreased calcium concentration. Measurement of albumin concentration can also be utilized for calcium correction calculation, as it binds calcium and deactivates it. Other tests detect elevated phosphorus or decreased parathyroid hormone levels, of which the latter may act as an earlier warning sign than calcium levels. Treatment consists of calcium and vitamin D supplementation (22).

The narrative review identified one systematic review that reported risk of permanent hypocalcaemia (indicative of permanent hypoparathyroidism) after thyroid surgery. This review focused only on thyroidectomies and reported a risk of permanent hypocalcaemia equal to 1% (0%-3%) with limited evidence of a higher risk in patients suffering from malignant disease (23).

However, several nationwide databases/registries and multicenter studies were also identified, reporting permanent hypoparathyroidism risk after thyroid cancer surgery for different types of thyroid cancer surgery. In these studies, the risk varied from 2.5% to 9.5%. The main characteristics and findings from some of these studies from literature are summarized in Table 5.

**Table 5:** Studies and reports for permanent postoperative hypoparathyroidism.

| # | Author                                        | Country       | Time Period | Sample type       | Sample size | Proportion with Hypoparathyroidism |
|---|-----------------------------------------------|---------------|-------------|-------------------|-------------|------------------------------------|
| 1 | <a href="#">Papaleontiou M. et al. (2017)</a> | United States | 1998 - 2011 | National database | 27,912      | 9.15%†                             |
| 2 | <a href="#">Thomush O. et al. (2003)</a>      | Germany       | 1998        | Multicenter study | 206         | 5.4% - 9.5% *†                     |
| 3 | <a href="#">Van Dijk D. et al. (2020)</a>     | Netherlands   | 1989 - 2009 | National database | 567         | 4.8%†                              |
| 4 | <a href="#">Rosato L. et al. (2004)</a>       | Italy         | 1995 - 2000 | Multicenter study | 1911        | 3.3%†                              |
| 5 | <a href="#">Benhamiche BE et al. (2022)</a>   | France        | 2011 - 2015 | National Database | 31,175      | 9.18%†                             |

† Risk calculated based only on thyroid cancer patients

\* varies across different types of thyroid cancer

In a large US population-based study, using the Surveillance, Epidemiology, and End Results–Medicare Linked database, representing approximately 28% of the US population from the Medicare database between 1998 and 2011, Papaleontiou et al. (19) reported a 5.1% risk of postoperative permanent hypoparathyroidism among individuals younger than 65 years and 13.6% among those aged 65 years and older. Across the thyroid cancer surgery cases, the overall risk was 9.15% (19). In Europe, a multi-center study gathered data using questionnaires across 45 hospitals in Germany, from 5,846 patients undergoing bilateral thyroid surgery, of which 206 were for thyroid carcinoma. The results highlighted that the risk of permanent hypoparathyroidism was 5.4% in those patients with primary carcinoma, while it significantly increased to 9.5% in patients with recurrent carcinoma (24). In the multicenter study by Rosato et al. in Italy, a risk of 3.3% for permanent hypocalcemia in malignant cases was reported, which was notably higher compared to the corresponding risk in the whole cohort (1.7%), which included both malignant and benign cases (11).

More recently, a population-based study covering the northern region of the Netherlands from 1989 to 2009, evaluated 567 patients with a prevalence of 4.8% of persistent hypocalcemia.

Since hypoparathyroidism is the primary cause of hypocalcemia in most cases, the prevalence of hypocalcemia may be slightly higher than that of hypoparathyroidism; however, the two are closely correlated, and the difference in their frequencies is not clinically significant (12). It should be noted that the study focuses on patients with differentiated thyroid cancer, which constitutes most thyroid cancer cases (25,26). Furthermore, a recent large national study assessed the prevalence of postoperative hypoparathyroidism following total or completion thyroidectomy for thyroid cancer in France. Among 31,175 thyroid cancer surgeries in adults between 2011 and 2015, hypoparathyroidism was frequent, affecting 42% of the cohort and requiring calcium/vitamin D supplementation. Moreover, 22% of this subgroup showed persistent disease at one year (9.18% of the total cohort) (27).

In Cyprus, for Indicator B, the percentage of patients who have undergone surgery for thyroid cancer between 12-24 months prior to the indicator assessment and have been diagnosed with permanent postoperative hypoparathyroidism within the previous 12 months was calculated at 3.1% in the baseline period. Following the introduction of the contextualized guideline, the indicator estimate was significantly lower at 0.6%, which compares favorably to corresponding estimates from other countries. At the same time, the percentage of patients who underwent surgery for thyroid cancer between 12-24 months prior to the indicator assessment and have been evaluated for postoperative hypoparathyroidism 12 months or more after the date of surgery, as calculated in Indicator D, was only 24.29% in the baseline period and even lower at 21.57% in the year after the implementation of the guideline. As in the case for the percentage of vocal cord paralysis assessment, there were no studies identified that specifically estimated the percentage of patients assessed for permanent hypoparathyroidism following thyroid surgery and as such no comparisons were made with other countries. Nevertheless, these findings combined should lead to a cautious interpretation of the Indicator B estimates for low risk of permanent hypoparathyroidism following thyroid cancer surgery as this may reflect limited postoperative evaluation. Only a small proportion of patients who underwent thyroid cancer surgery were assessed for hypoparathyroidism, which may underestimate the true burden of this complication in Cyprus.

## **5. Factors affecting thyroid cancer surgery complication rates and suggestions for quality-of-care improvement**

The narrative review offered several insights about the association of different surgical and non-surgical factors with post-operative hypoparathyroidism and/or vocal fold paralysis. Several of these factors have been discussed in a recent systematic review focusing on hypoparathyroidism (28) and are presented in a narrative manner below. These factors serve as a base to form suggestions for the improvement of quality-of-care in thyroid cancer surgical management in Cyprus.

## **5.1 Surgery risk**

### **5.1.1 Extent of surgery**

Several types of surgeries may be performed to treat thyroid carcinoma, depending on the size or the stage of the tumor. More extensive surgeries, though, may endanger vulnerable anatomical structures, such as the parathyroid glands and the recurrent laryngeal nerve, which may increase the risk of permanent hypoparathyroidism and vocal cord paralysis. The least invasive and risky type of surgery is lobectomy, also known as hemithyroidectomy, as it poses less risk compared to the more advanced total thyroidectomy. Specifically, the Relative Risk (RR) in patients who underwent total thyroidectomy compared to hemithyroidectomy was 3.17 [95% Confidence Interval (CI): 1.72-5.83] for permanent hypocalcemia and 1.85 (95%CI: 1.28-2.69) for permanent vocal cord paralysis, as estimated in a systematic review and meta-analysis by Kandil et al. (29). Similar risk increases were estimated in large population studies such as the Medicare based study by Papaleontiou et al, which estimated an Odds Ratio (OR) of 1.59 (95%CI: 1.41-1.80) for thyroid surgery complications for the same comparison (19).

Furthermore, additional dissections for lymph node removal may be needed, either for prophylactic or therapeutic reasons, to minimize the probability of thyroid carcinoma spreading to the adjacent lymph nodes. However, these procedures increase the risk of developing certain complications such as permanent vocal cord paralysis and permanent hypoparathyroidism. For example, a meta-analysis that evaluated the efficacy and safety of prophylactic central lymph node dissection, did show significantly lower risk of locoregional cancer recurrence (OR: 0.65, 95%CI: 0.48-0.88) but the risk of permanent hypocalcemia was also significantly increased (OR: 2.22, 95%CI:1.58-3.13). There was no significant difference for permanent RLN paralysis (OR: 1.31, 95%CI: 0.75-2.27), indicating that the parathyroid glands are more affected in this procedure (30). Additionally, the extent of lymph node removal may also increase the risk of complications as indicated by Giordano et al., which found that bilateral central neck dissection

was associated with higher risk of permanent hypoparathyroidism (OR: 2.86, 95% CI: 1.73–4.74), when compared to unilateral or without any central lymph node dissection (31).

Similarly, lateral neck dissections are needed in cases of metastasis to lateral lymph nodes, although this procedure, when performed in combination with total thyroidectomy, significantly increases the risk of permanent RLN paralysis and hypoparathyroidism. In a large study aiming to determine the complication profile for total thyroidectomy with and without simultaneous lateral neck dissection using an administrative database, among the full cohort, 4.7% were diagnosed with permanent postoperative hypoparathyroidism and 0.7% with permanent vocal cord paralysis. However, among those that underwent unilateral lymph node dissections, the corresponding percentages were increased at 8.8% and 1.9%, while among those with bilateral, these were even higher at 10.9% and 2.1% (32).

### **5.1.2 Reoperations**

Another major risk factor for postoperative complications after thyroid cancer surgery, such as permanent hypoparathyroidism and vocal cord paralysis, is reoperation. Reoperation in a previously operated surgical field is a technically demanding procedure that requires caution, as the operative site and surrounding structures have already undergone significant postoperative changes. Specifically, the formation of fibrotic scar tissue, distorted anatomical planes, and dense adhesions around the RLN and parathyroid glands make dissection more difficult. Additionally, there is often loss of natural tissue planes and reduced parathyroid vascularization, which may further complicate visualization and preservation of these delicate structures (7,8).

The higher risk for postoperative complications after reoperation is supported by several studies. Lefevre et al. reported a risk of permanent RLN paralysis of 1.5% after secondary surgery compared with 0.5% after primary. In the same study, the risk of permanent hypocalcemia was 2.5% after secondary and 1.8% after primary procedures, although this difference was not statistically significant (33). Similarly, Medas et al. observed a significantly higher risk of permanent hypoparathyroidism after secondary thyroidectomy (10%) compared to primary thyroidectomy (2%) (34), while Hayward et al. reported a substantial increase in permanent RLN paralysis in reoperation compared to primary procedures, with corresponding risks of 0.74% and 0.13%, respectively (13). Lastly, in the Dutch population-based study by Van Dijk et al. it has been

estimated that persistent recurrent palsy occurred in 5.9% of reoperations, while the overall rate was 4.8% (12).

### **Suggestion 1**

#### **Preoperative multidisciplinary team (MDT) meetings and formal surgical plan assessments**

- Note: Promotion of preoperative MDT meetings and formal surgical plan assessments for thyroid cancer cases, particularly when extensive surgery or reoperation is anticipated. This can be implemented by documenting the risk-benefit evaluation before surgery and establishing standardized and topic-specific checklists within clinical care settings.

### **5.2 Surgery volume and specialization**

Another factor that significantly affects the risk of postoperative complications in thyroid cancer management is the surgeon's volume of thyroid surgery procedures per year. In general, and despite the varying cut-offs used to define low, intermediate, and high case volume, an inverse association between case volume and postoperative complications has been consistently reported in multiple studies (35-37). In addition, evidence shows that surgeries conducted by trainees, supervised by an experienced and specialized surgeon, do not further increase the complication risk, whereas surgeons that are not specialized in thyroid surgeries are often characterized by a higher postoperative complication rate, thus also highlighting the importance of specialization. Not surprisingly, there is evidence that formal, thyroid-focused specialty training influences morbidity more strongly than annual caseload. Surgeons who completed dedicated thyroid training in lower-volume provincial centers demonstrated recurrent laryngeal nerve palsy rates comparable to those seen in high-volume metropolitan endocrine surgery units, underscoring the primacy of specialized training over caseload alone (7).

### **Suggestion 2**

#### **Support training and experience-sharing mechanisms**

- Note: Structured training pathways (including formal training for thyroid cancer surgery) should be further promoted. Additionally, experience-sharing mechanisms can be implemented by establishing supervised trainings within teaching hospitals and organizing regular joint operating sessions and case-review workshops.

### **5.3 Preoperative voice assessment**

Performing preoperative laryngoscopy does not prevent RLN injury, but it is essential for detecting pre-existing vocal cord dysfunction, which could better guide the surgeon's strategy and directly improve surgical planning. This is particularly important in the case of patients with preoperative RLN paralysis due to tumor infiltration or previous surgery and of risk of bilateral vocal cord paralysis if the contralateral nerve is also injured intraoperatively (7, 38-40).

#### **Suggestion 3**

##### **Preoperative vocal cord function assessment**

- Note: Support and promote preoperative laryngoscopy for all patients scheduled for thyroid cancer surgery, especially in the case of reoperations.

### **5.4 Intraoperative identification and preservation of RLN and parathyroid glands**

#### **5.4.1 Systematic visual identification of the recurrent laryngeal nerve (RLN)**

Evidence demonstrates that centers where the RLN is routinely identified have significantly lower RLN palsy rates. For example, in the study by Hermann et al., which included 27,000 nerve at risk (NAR) cases, the rate of permanent recurrent laryngeal nerve palsy (RLNP) was 0.4% when the nerve was identified, compared with 1.1% when it was not, a difference that was statistically significant (41). More contemporary studies confirmed and further strengthened these findings and visual identification of the RLN or its non-recurrent variant is considered the gold standard in thyroid surgery (7,8,42). In cases involving scar tissue, reoperations, or distorted anatomy, the use of microsurgical instruments, low-power bipolar coagulation, and magnification tools (loupes or an operating microscope) is recommended to facilitate safe nerve identification.

#### **Suggestion 4**

##### **Training of surgical staff on systematic intraoperative visual RLN identification**

- Note: In line with Suggestion 2, surgeons should receive specialized training to develop the skills and experience required for consistent and correct RLN identification and preservation even in challenging surgical fields such as those with malignancy and/or fibrosis.

#### **5.4.2 Intraoperative neuromonitoring (IONM) equipment**

The use of intermittent or continuous IONM is particularly advisable in thyroid surgeries involving malignancy (primary operation or re-operation), or when anatomical landmarks are distorted. IONM assists in nerve mapping, verifies functional integrity, and supports intraoperative decision-making (e.g., staging surgery when loss of signal occurs). This technology enhances the safety and accuracy of RLN identification, especially in complex surgical environments where visual cues may be unreliable (43). However, current evidence indicates that IONM alone does not significantly reduce the incidence of vocal fold paralysis compared to visual nerve identification alone. For instance, a meta-analysis on thyroidectomies (of all etiologies) by Higgins et al., which included 64,699 nerves-at-risk from one randomized clinical trial, seven comparative studies, and 34 case series, found no statistically significant difference in transient or permanent vocal fold paralysis between IONM and visual identification groups and this was also the case in the subgroup analysis that included only surgeries for malignant etiology (44). Therefore, IONM should be regarded as an adjunct tool rather than a substitute for meticulous surgical dissection and anatomical identification (13,38,39).

### **Suggestion 5**

#### **Consideration of using intraoperative neuromonitoring (IONM) as an adjunct modality**

- Note: Access to imaging and intraoperative neuromonitoring (IONM) equipment could be promoted and ensure that appropriate training is available for surgeons undertaking thyroid cancer surgery.

### **5.5 Preservation of parathyroid glands**

As in the case of minimizing the risk for vocal cord paralysis, the best prevention for any complication involving the parathyroid glands remains meticulous surgical technique: systematic visual identification, preservation of the parathyroid glands in situ, maintenance of their vascular supply and avoidance of unnecessary devascularisation or removal. Therefore, anatomical knowledge and experience, in combination with careful evaluation and recognition of the parathyroid glands, will positively impact the complication rate. While autotransplantation of the gland is recommended if a gland is inadvertently removed or devascularized and some researchers have advocated routine (protective) parathyroid gland autotransplantation to protect its function, a recent systematic review and meta-analysis demonstrated that this procedure does not lead to a decrease in the risk of permanent post-thyroidectomy hypoparathyroidism compared to patients whose parathyroid glands were preserved in situ (45).

This was also evident in a separate systematic review and meta-analysis about the effectiveness of parathyroid gland autotransplantation in preserving parathyroid function during thyroid surgery for thyroid neoplasms, where the RR for protracted hypoparathyroidism in patients who underwent parathyroid gland autotransplantation versus (vs) patients who did not undergo parathyroid gland autotransplantation was non-significant at 0.93 (95% CI: 0.49–1.75) (46).

### **Suggestion 6**

#### **Training of surgical staff on systematic visual parathyroid glands' identification**

- Note: In line with Suggestion 2, surgeons should receive specialized training to develop the skills and experience required for consistent and correct parathyroid gland identification and preservation even in challenging surgical fields such as those with malignancy and/or fibrosis.

## **6. Summary**

In summary, the introduction of the contextualized NG230 'Thyroid cancer: assessment and management' guideline into the Cyprus healthcare system enabled the structured evaluation of thyroid cancer quality indicators for the first time. Early results show that the risk of permanent postoperative vocal cord paralysis or permanent postoperative hypoparathyroidism in patients that have undergone thyroid cancer surgery is low. However, the percentage of patients undergoing assessments for permanent postoperative vocal cord paralysis and hypoparathyroidism also remains very low, in both the baseline and reporting periods. As a result, the possibility of underestimating the risk of these complications in this population cannot be excluded. To address these gaps and further improve quality of care, especially in terms of minimizing the risks of postoperative permanent vocal cord paralysis and hypoparathyroidism, the report outlines practical suggestions such as enhancing surgeon training and experience-sharing mechanisms as well as promoting routine preoperative laryngoscopy and MDT-based surgical planning.

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## **APPENDIX I**

### **Quality Indicators for the guideline “Thyroid cancer: assessment and management”**

#### **Indicator A**

The percentage of patients who have undergone thyroid cancer surgery in the previous 12 to 24 months, who have been diagnosed with permanent postoperative vocal cord paralysis.

#### **Indicator type**

Quality Indicator.

#### **Rationale**

Potential complications of thyroid surgery include laryngeal nerve injury causing vocal cord immobility. Vocal cord paralysis may be unilateral or bilateral and could be transient or permanent. Vocal cord paralysis following thyroidectomy is rare, but symptoms may vary from hoarseness to severe life-threatening respiratory distress, especially if bilateral. The definition of “permanent postoperative vocal cord paralysis” is the immobility of one (or both) vocal cords, 6 months or more after thyroid cancer surgery. This indicator aims to monitor the percentage of patients diagnosed with permanent postoperative vocal cord paralysis following thyroid cancer surgery.

#### **Specification**

Numerator: The number of patients in the denominator who have been diagnosed with permanent postoperative vocal cord paralysis, 6 months or more after the surgery date

Denominator: The number of patients who have undergone thyroid cancer surgery in the previous 12-24 months. .

Calculation:  $(\text{Numerator}/\text{denominator}) \times 100$

- Calculated on an annual basis, at the end of each year.
- Calculated for each surgeon.

Exclusions: Patients with pre-existing vocal cord paralysis or other vocal cord abnormality.

Minimum population: The indicator is appropriate to assess performance across surgeons.

### **Indicator B**

The percentage of patients who have undergone thyroid cancer surgery between 12-24 months before indicator assessment and have been diagnosed with permanent postoperative hypoparathyroidism in the preceding 12 months.

### **Indicator type**

Quality Indicator.

### **Rationale**

Postoperative hypoparathyroidism is caused by a decrease in parathyroid hormone (PTH) in circulation due to the reduced volume of functional parathyroid parenchyma, related to inadvertent resection or devascularization of one or more parathyroid glands during thyroid surgery. Transient hypoparathyroidism affects a subset of thyroid operated patients and some of them may develop permanent hypoparathyroidism. This indicator aims to monitor the percentage of patients diagnosed with permanent postoperative hypoparathyroidism following thyroid cancer surgery. Since persistence of hypoparathyroidism for 12 months or more is required for it to be considered permanent, the indicator applies to surgeries carried out between 12-24 months before the time of indicator assessment and aims to capture diagnoses within the preceding 12 months.

### **Specification**

Numerator: The number of patients in the denominator who have been diagnosed with permanent postoperative hypoparathyroidism 12 months or more after the surgery date.

Denominator: The number of patients who have undergone thyroid cancer surgery between 12-24 months before the time of indicator assessment

Calculation:  $(\text{Numerator}/\text{denominator}) \times 100$

- Calculated on an annual basis, at the end of each year.
- Calculated for each surgeon.

Minimum population: The indicator is appropriate to assess performance at the surgeon level.

### **Indicator C**

The percentage of patients who have undergone thyroid cancer surgery in the previous 12-24 months, who have been assessed for permanent postoperative vocal cord paralysis, 6 months or more after the surgery date.

#### **Indicator type**

Quality indicator

#### **Rationale**

Potential complications of thyroid surgery include laryngeal nerve injury causing vocal cord immobility. Vocal cord paralysis may be unilateral or bilateral and could be transient or permanent. Bilateral vocal cord paralysis following thyroidectomy is rare, but symptoms may vary from hoarseness to severe life-threatening respiratory distress, especially if bilateral cords are involved. The definition of “permanent postoperative vocal cord paralysis” is the immobility of one (or both) vocal cords, 6 months or more after thyroid cancer surgery. This indicator aims to monitor the percentage of patients assessed with permanent postoperative vocal cord paralysis following thyroid cancer surgery.

#### **Specification**

Numerator: The number of patients in the denominator who have been assessed for permanent postoperative vocal cord paralysis 6 months or more after the surgery date.

Denominator: The number of patients who have undergone thyroid cancer surgery in the previous 12-24 months.

Calculation:  $(\text{Numerator}/\text{denominator}) \times 100$

- Calculated on an annual basis, at the end of each year.
- Calculated at the surgeon level.

Exclusions: No exclusions apply for this indicator.

Minimum population: The indicator is appropriate to assess performance at the surgeon level.

### **Indicator D**

The percentage of patients who have undergone thyroid cancer surgery between 12-24 months before indicator assessment and have been assessed for postoperative hypoparathyroidism 12 months or more after the surgery date.

#### **Indicator type**

Quality Indicator.

#### **Rationale**

Postoperative hypoparathyroidism is caused by a decrease in parathyroid hormone (PTH) in circulation due to the reduced functional total parathyroid parenchyma volume related to inadvertent resection or devascularization and injury of one or more parathyroid glands by mechanical or thermal trauma during thyroid surgery. Transient hypoparathyroidism affects a subset of thyroid operated patients and some of them may develop permanent hypoparathyroidism. This indicator aims to monitor the percentage of patients diagnosed with permanent postoperative hypoparathyroidism following thyroid cancer surgery. Since persistence of hypoparathyroidism for 12 months or more is required for it to be considered permanent, the indicator applies to surgeries carried out between 12-24 months before the time of indicator assessment and aims to capture assessments for hypoparathyroidism within the preceding 12 months.

#### **Specification**

Numerator: The number of patients in the denominator who have been assessed for permanent postoperative hypoparathyroidism, 12 months or more after the surgery date.

Denominator: The number of patients who underwent thyroid cancer surgery between 12-24 months before the time of indicator assessment.

Calculation:  $(\text{Numerator}/\text{denominator}) \times 100$

- Calculated on an annual basis, at the end of each year.
- Calculated at the surgeon level.

Exclusions: No exclusions apply for this indicator.

Minimum population: The indicator is appropriate to assess performance at the endocrine specialist level.

## **APPENDIX II**

### **BUSINESS RULES (Quality Indicators' calculation algorithms)**

The “Business Rules” Appendix complements the contextualized NICE Guideline NG230 on “Thyroid cancer: assessment and management” and can be used as an aid to understand the patient groups and activities included in each indicator output.

**Important information:** *The draft business rules format employed here follows the format described by NHS Digital in the Business Rules Supporting Information (Version 1.2 – 01/04/2017) and consists of two main sections:*

- *Dataset specification*
  - *Qualifying Dates (number of dates to determine the relevant period(s) to extract data for and for identifying which activity to include in each extract)*
    - *Reporting Period Start Date (RPSD)*
    - *Reporting Period End Date (RPED)*
    - *Qualifying dates determine a quality service period for which the indicator is assessed. The quality service period can be defined differently using different RPSD and/or RPED, depending on the nature of data collection (cumulative data collection Vs non-cumulative data collection).*
  - *Patient selection criteria (definition of patient populations, further criteria define the clinical aspects of interest using appropriate internal, national, or international coding system in line with the format used in the HIO electronic system)*
    - *The patient selection criteria can be applied at the individual doctor level and/or GESY level.*
  - *Populations (Subsets of patients to which further logic rules may apply).*
  - *Clinical code clusters (may need to be specified for any dates associated with them to be identified)*
  - *Clinical data extraction criteria (data items to be exported from the HIO electronic system for subsequent processing)*
- *Data export – Output*
  - *Data exports are provided with a name and a description and state for which population the logic rule(s) should be applied to.*
  - *The output forms an indicator which may comprise*
    - *A single count of patients meeting the criteria*
    - *A numerator and denominator combination producing a fractional figure*
      - *Separate logic rules may be required to be specified for numerator and denominator population*
    - *A Boolean TRUE/FALSE result*

**Indicator A:** The percentage of patients who have undergone thyroid cancer surgery in the previous 12 to 24 months, who have been diagnosed with permanent postoperative vocal cord paralysis.

Indicator A business rules:

Reporting period -> At the end of each year -> non-cumulative data collection

Reporting unit (minimum population) -> across the whole GESY, to assess performance at each individual surgeon level.

RPSD = e.g. 01/01/2023

RPED = e.g. 31/12/2023

Calculation: (Numerator/denominator)\*100

| Denominator              |                                                           |                |                 |                                                                                                                                                                     |
|--------------------------|-----------------------------------------------------------|----------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rule number              | Rule                                                      | Action if true | Action if false | Rule description or comments                                                                                                                                        |
| 1                        | IF THYR_CANC = 1                                          | Next Rule      | Reject          | Rule 1 allows the selection of all patients with a thyroid cancer diagnosis (coding depending on current HIO system configuration)                                  |
| 2                        | IF THYR_SURG = 1                                          | Next Rule      | Reject          | Rule 2 allows the selection of a subset of patients with a thyroid cancer diagnosis that have undergone thyroid surgery                                             |
| 3                        | IF (RPED – 24 MONTHS < THYR_SURG_DATE < RPED – 12 MONTHS) | Select         | Reject          | Rule 3 allows the selection of a subset of thyroid cancer patients that have undergone thyroid surgery between 12-24 months before the date of indicator evaluation |
| End of denominator rules |                                                           |                |                 |                                                                                                                                                                     |

THYR\_CANC=Thyroid Cancer Diagnosis, THYR\_SURG=Thyroid Surgery, THYR\_SURG\_DATE=Thyroid Surgery Date

| Numerator              |                                                  |                |                 |                                                                                                                                                            |
|------------------------|--------------------------------------------------|----------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rule number            | Rule                                             | Action if true | Action if false | Rule description or comments                                                                                                                               |
| 1                      | IF VC_PAR_TEST = 1                               | Next Rule      | Reject          | Rule 1 allows the selection of a subset of patients who had undergone assessment of vocal cord paralysis                                                   |
| 2                      | IF (VC_PAR_TEST_DATE > THYR_SURG_DATE +6 MONTHS) | Next Rule      | Reject          | Rule 2 allows the selection of a subset of patients assessed for vocal cord paralysis 6 months or more after the performance of a thyroid cancer operation |
| 3                      | IF PERM_VC_PAR = 1                               | Select         | Reject          | Rule 3 allows the selection of a subset of patients with a diagnosis of permanent vocal cord paralysis                                                     |
| End of numerator rules |                                                  |                |                 |                                                                                                                                                            |

VC\_PAR\_TEST = Assessment for Vocal Cord Paralysis, VC\_PAR\_TEST\_DATE= Assessment for Vocal Cord Paralysis Date, THYR\_SURG\_DATE=Thyroid Surgery Date PERM\_VC\_PAR=Diagnosis of Permanent Vocal Cord Paralysis

**Indicator B:** The percentage of patients who have undergone thyroid cancer surgery between 12-24 months before indicator assessment and have been diagnosed with permanent postoperative hypoparathyroidism, in the preceding 12 months.

Indicator Additional B business rules:

Reporting period -> At the end of each year -> non-cumulative data collection

Reporting unit (minimum population) -> across the whole GESY, to assess performance at each individual surgeon level.

RPED = e.g. 01/01/2023, RPED = e.g. 31/12/2023 Calculation: (Numerator/denominator)\*100

| Denominator              |                                                           |                |                 |                                                                                                                                                                     |
|--------------------------|-----------------------------------------------------------|----------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rule number              | Rule                                                      | Action if true | Action if false | Rule description or comments                                                                                                                                        |
| 1                        | IF THYR_CANC = 1                                          | Next Rule      | Reject          | Rule 1 allows the selection of all patients with a thyroid cancer diagnosis (coding depending on current HIO system configuration)                                  |
| 2                        | IF THYR_SURG = 1                                          | Next Rule      | Reject          | Rule 2 allows the selection of a subset of patients with a thyroid cancer diagnosis that have undergone thyroid surgery                                             |
| 3                        | IF (RPED – 24 MONTHS < THYR_SURG_DATE < RPED – 12 MONTHS) | Select         | Reject          | Rule 3 allows the selection of a subset of thyroid cancer patients that have undergone thyroid surgery between 12-24 months before the date of indicator evaluation |
| End of denominator rules |                                                           |                |                 |                                                                                                                                                                     |

THYR\_CANC=Thyroid Cancer Diagnosis, THYR\_SURG=Thyroid Surgery, THYR\_SURG\_DATE=Thyroid Surgery Date, PARATH\_TEST=Parathyroid Hormone Test, PARATH\_TEST\_DATE=Parathyroid Hormone Test Date

| Numerator              |                                                   |                |                 |                                                                                                                                                                                                                                                |
|------------------------|---------------------------------------------------|----------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rule number            | Rule                                              | Action if true | Action if false | Rule description or comments                                                                                                                                                                                                                   |
| 1                      | IF PARATH_TEST = 1                                | Next Rule      | Reject          | Rule 1 allows the selection of a subset of thyroid cancer patients who have undergone thyroid surgery at the determined time interval and have been assessed for parathyroid hormone levels                                                    |
| 2                      | IF (PARATH_TEST_DATE > THYR_SURG_DATE +12 MONTHS) | Next Rule      | Reject          | Rule 2 allows the selection of a subset of thyroid cancer patients who have undergone thyroid surgery at the determined time interval and have been assessed for parathyroid hormone levels 12 months or more after the thyroid cancer surgery |
| 3                      | IF PERM_HYP_PTH = 1                               | Select         | Reject          | Rule 3 allows the selection of a subset of patients with a diagnosis of permanent hypoparathyroidism                                                                                                                                           |
| End of numerator rules |                                                   |                |                 |                                                                                                                                                                                                                                                |

PARATH\_TEST=Parathyroid Hormone Test, PARATH\_TEST\_DATE=Parathyroid Hormone Test Date, THYR\_SURG\_DATE=Thyroid Surgery Date, PERM\_HYP\_PTH=Diagnosis of permanent hypoparathyroidism

**Indicator C:** The percentage of patients who have undergone thyroid cancer surgery in the previous 12-24 months, who have been assessed for postoperative vocal cord paralysis.

Indicator Additional C business rules:

Reporting period -> At the end of each year -> non-cumulative data collection

Reporting unit (minimum population) -> across the whole GESY, to assess performance at each individual surgeon level.

RPSD = e.g. 01/01/2023

RPED = e.g. 31/12/2023

Calculation: (Numerator/denominator)\*100

| Denominator                     |                                                           |                |                 |                                                                                                                                                                     |
|---------------------------------|-----------------------------------------------------------|----------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rule number                     | Rule                                                      | Action if true | Action if false | Rule description or comments                                                                                                                                        |
| 1                               | IF THYR_CANC = 1                                          | Next Rule      | Reject          | Rule 1 allows the selection of all patients with a thyroid cancer diagnosis (coding depending on current HIO system configuration)                                  |
| 2                               | IF THYR_SURG = 1                                          | Next Rule      | Reject          | Rule 2 allows the selection of a subset of patients with a thyroid cancer diagnosis that have undergone thyroid surgery                                             |
| 3                               | IF (RPED – 24 MONTHS < THYR_SURG_DATE < RPED – 12 MONTHS) | Select         | Reject          | Rule 3 allows the selection of a subset of thyroid cancer patients that have undergone thyroid surgery between 12-24 months before the date of indicator evaluation |
| <i>End of denominator rules</i> |                                                           |                |                 |                                                                                                                                                                     |

THYR\_CANC=Thyroid Cancer Diagnosis, THYR\_SURG=Thyroid Surgery, THYR\_SURG\_DATE=Thyroid Surgery Date

| Numerator                     |                                                  |                |                 |                                                                                                                                                            |
|-------------------------------|--------------------------------------------------|----------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rule number                   | Rule                                             | Action if true | Action if false | Rule description or comments                                                                                                                               |
| 1                             | IF VC_PAR_TEST = 1                               | Next Rule      | Reject          | Rule 1 allows the selection of a subset of patients who had undergone assessment of vocal cord paralysis                                                   |
| 2                             | IF (VC_PAR_TEST_DATE > THYR_SURG_DATE +6 MONTHS) | Select         | Reject          | Rule 2 allows the selection of a subset of patients assessed for vocal cord paralysis 6 months or more after the performance of a thyroid cancer operation |
| <i>End of numerator rules</i> |                                                  |                |                 |                                                                                                                                                            |

VC\_PAR\_TEST=Assessment of Permanent Vocal Cord Paralysis, VC\_PAR\_TEST\_DATE=Date of Assessment of Vocal Cord Paralysis, THYR\_SURG\_DATE=Thyroid Surgery Date

**Indicator D:** The percentage of patients who have undergone thyroid cancer surgery between 12-24 months before indicator assessment and have been assessed for postoperative hypoparathyroidism in the preceding 12 months.

Indicator Additional D business rules:

Reporting period -> At the end of each year -> non-cumulative data collection

Reporting unit (minimum population) -> across the whole GESY, to assess performance at each individual endocrine specialist level.

RPSD = e.g 01/01/2023

RPED = e.g. 31/12/2023

Calculation: (Numerator/denominator)\*100

| Denominator              |                                                           |                |                 |                                                                                                                                                                     |
|--------------------------|-----------------------------------------------------------|----------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rule number              | Rule                                                      | Action if true | Action if false | Rule description or comments                                                                                                                                        |
| 1                        | IF THYR_CANC = 1                                          | Next Rule      | Reject          | Rule 1 allows the selection of all patients with a thyroid cancer diagnosis (coding depending on current HIO system configuration)                                  |
| 2                        | IF THYR_SURG = 1                                          | Next Rule      | Reject          | Rule 2 allows the selection of a subset of patients with a thyroid cancer diagnosis that have undergone thyroid surgery                                             |
| 3                        | IF (RPED – 24 MONTHS < THYR_SURG_DATE < RPED – 12 MONTHS) | Select         | Reject          | Rule 3 allows the selection of a subset of thyroid cancer patients that have undergone thyroid surgery between 12-24 months before the date of indicator evaluation |
| End of denominator rules |                                                           |                |                 |                                                                                                                                                                     |

THYR\_CANC=Thyroid Cancer Diagnosis, THYR\_SURG=Thyroid Surgery, THYR\_SURG\_DATE=Thyroid Surgery Date, PARATH\_TEST=Parathyroid Hormone Test, PARATH\_TEST\_DATE=Parathyroid Hormone Test Date

| Numerator              |                                                   |                |                 |                                                                                                                                                |
|------------------------|---------------------------------------------------|----------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| Rule number            | Rule                                              | Action if true | Action if false | Rule description or comments                                                                                                                   |
| 1                      | IF PARATH_TEST = 1                                | Next Rule      | Reject          | Rule 1 allows the selection of a subset of patients who have been assessed for parathyroid hormone levels                                      |
| 2                      | IF (PARATH_TEST_DATE > THYR_SURG_DATE +12 MONTHS) | Select         | Reject          | Rule 2 allows the selection of a subset of patients assessed for parathyroid hormone levels 12 months or more after the thyroid cancer surgery |
| End of numerator rules |                                                   |                |                 |                                                                                                                                                |

PARATH\_TEST= Parathyroid Hormone Test, PARATH\_TEST\_DATE= Parathyroid Hormone Test Date

**APPENDIX III****Diagnoses codes included in Quality Indicators' calculation algorithms**

| # | Diagnosis                            | Code                                                                                                                                                                                                                                                                   |
|---|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Thyroid Cancer Diagnosis             | C73, C75.0, D09.3                                                                                                                                                                                                                                                      |
| 2 | Thyroid Cancer Surgery               | 306.01.00, 306.01.02, 306.01.98, 306.01.99, 306.02.00, 306.02.01, 306.02.04, 306.02.05, 306.02.06, 306.02.07, 306.02.08, 306.02.98, 306.02.99, 306.03.00, 306.03.02, 306.03.04, 306.03.98, 306.03.99, 306.04.00, 306.04.01, 306.04.02, 306.04.03, 306.04.98, 306.04.99 |
| 3 | Laryngoscopy                         | 31505, 31513, 31572, 31573, 31574, 31575, 31575-58, 31576, 31577, 31579, 92520                                                                                                                                                                                         |
| 4 | Vocal cords paralysis diagnosis      | J38.0                                                                                                                                                                                                                                                                  |
| 5 | Lab referral for parathyroid hormone | 2731-8 PTH                                                                                                                                                                                                                                                             |
| 6 | Post-operative hypoparathyroidism    | E89.2                                                                                                                                                                                                                                                                  |