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Vitae
THYROID CANCER

A NEW UNDERWRITING SOLUTION
developed to provide insurance coverage
for people with a history of thyroid cancer

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Introduction and Context

Thyroid cancer is a disease in which malignant (cancerous) cells form in the tissues of the thyroid gland, an organ located at the base of the throat and responsible for regulating many metabolic processes. There are several pathological subtypes of thyroid cancer including papillary, follicular, medullary, undifferentiated/ anaplastic, and other carcinomas. Among this heterogeneous variety of tumor types, papillary and follicular, also labeled together as epithelial carcinomas, are the most frequently observed. But they are also often slow-growing and associated with a good prognosis. Conversely, medullary and undifferentiated/anaplastic (as well as many so-called "others") carcinomas are less represented but display more rapid growth and poorer prognosis.

The risks associated with thyroid cancer may depend on several factors (called "prognostic parameters" in medical terms). One such parameter is the duration since the diagnosis - more precisely, since the beginning of the treatment. Like most other cancer types, the thyroid cancer-specific mortality rate stands higher in the first years of treatment and then drastically decreases. Importantly, age has been identified for a long time as a very important prognostic parameter for mortality and relapse rates of epithelial thyroid cancer with a higher risk in older individuals compared to younger individuals. Finally, histology, tumor size (T), number of regional lymph nodes involved (N) and distant metastases (M) are also important in assessing the prognosis of the disease. Thyroid cancer remains a mostly curable cancer, with approximately half a million diagnosed cases annually worldwide and (all cases included) a 5-year survival rate of 98.3%.

In this paper, we have revisited most of the usual, medically accepted, and validated parameters identified by physicians at the diagnosis to decide on adapted therapies. Developing a more inclusive underwriting program for people with thyroid cancer histories requires very detailed knowledge of these prognostic parameters. Moreover, with the recent advances in Machine Learning and the availability of specialized rich data, the quality of predictions is expected to improve significantly.

This has led to our recent development of Vitae Thyroid Cancer. Combining state-of-the-art technologies, actuarial techniques and medical knowledge, this underwriting solution aims to assess the risk of relapse and death for individuals previously diagnosed with thyroid cancer, based on a wide range of parameters that are good predictors of recurrence and death. This advanced solution allows improved accuracy in estimating individualized risk assessment and underwriting.

Vitae Thyroid Cancer: an underwriting solution to assess thyroid cancer risk

AN UNDERWRITING SOLUTION TO ASSESS THYROID CANCER RISK

Vitae Thyroid Cancer risk calculator can simplify the underwriter's work by gathering all the information necessary to compute the applicant's risk with a specific, secure, and user-friendly web-based application. In assessing the risk of an in-compete-remission applicant with a history of thyroid cancer, the solution uses six risk factors - age, duration since diagnosis, histology, tumor size, number of involved nodes and metastasis. Each variable (called risk factor) has several modalities that make thyroid cancer one of the tumors for which a 'multifactorial' risk evaluation justifies the need for a new comprehensive tool, according to the eighth edition AJCC Cancer Staging Manual.

GOOD PROGNOSIS IN YOUNG PEOPLE AND PAPILLARY/FOLLICULAR THYROID CANCER

Unlike in several other tumor types, age was considered to be a highly significant prognostic parameter of thyroid cancer mortality for well-differentiated epithelial carcinomas (papillary/follicular). The higher the age, the higher the risk of death. Among well-differentiated thyroid carcinomas, the pathological subtype, the TNM (tumor, node and metastasis) status, and age are routinely used to identify good or poor prognoses. Thus far, the AJCC-TNM classification shows that patients with any stage (including N+ and metastases) and younger than age 45 at the time of diagnosis are patients with a very good prognosis. Conversely, for patients aged 45 and older, the TNM classification informs groups of medium or high risk of death in well-differentiated epithelial carcinoma (papillary/follicular). Importantly, age does not seem to play such a role in identifying the risk of death in histologies other than papillary and follicular carcinoma (i.e., age does not play a role in describing the outcome of medullary, anaplastic/undifferentiated, and other carcinoma being associated with a high mortality rate).

Histology

Papillary / Follicular — Age

Other histologies — Worse prognosis
The 5-year mortality rate for non-metastasis individuals is 8.1% (vs 4.6% for papillary and follicular histologies) and for metastatic individuals 79.6% (vs 33.5% for papillary and follicular histologies)

≥ 45 years — TNM classification

< 45 years — Better prognosis
The 5-year mortality rate for non-metastasis individuals is **0.06%**. It remains high for metastatic individuals 10.4%.

Non-metastatic individuals / Metastatic individuals

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Vitae

Vitae Thyroid Cancer is based on medical data and actuarial science validated with medical expertise

THE SEER DATABASE PROVIDES A WEALTH OF INFORMATION ON THYROID CANCER

The Vitae Thyroid Cancer algorithm was built using the SEER (Surveillance, Epidemiology and End Result) database. SEER is the world's largest database specialized in cancer, providing information on biometric (age at diagnosis, etc.), medical (tumor size, tumor stage, etc.) and therapeutic (surgery, chemotherapy, etc.) data, making it possible to monitor the vital state of the patient. (NIH, s.d.)

We selected the SEER database for the following reasons:

- **Reliability:** SEER data is built through partnerships with several laboratories and government agencies, ensuring the reliability and accuracy of the information gathered.

- **Scientific validation:** This database is used worldwide by researchers and statisticians to conduct their work and publish figures on cancer incidence, prevalence, and mortality.

- **Size:** It is the largest cancer database in the world, with more than 400,000 observations added annually, ensuring the statistical power of results.

- **Representativity:** This database is representative of the American population in terms of socio-professional criteria. Some careful thought can be applied to adapt to another specific population around the world.

RELAPSE RISK MODELING

The pricing model behind the Vitae Thyroid Cancer integrates the risk of relapse. The model calculates the extra premium (i.e., the extra mortality) of an applicant with a history of thyroid cancer. In other words, it is the same as determining the probability of this person with a relapse dying specifically from this disease. Estimated probabilities of death are used as the first step of the computation. Having a comprehensive database is just the starting point. To provide the fairest pricing, we based the model on the following medical findings:

1. A person in remission from cancer (i.e., after treatment) may relapse locally (non-metastatic relapse) or develop metastasis (metastatic relapse).

2. A person with thyroid cancer, or in remission, only dies from cancer if they have metastasis (gone from non-metastatic to metastatic or metastatic relapse).
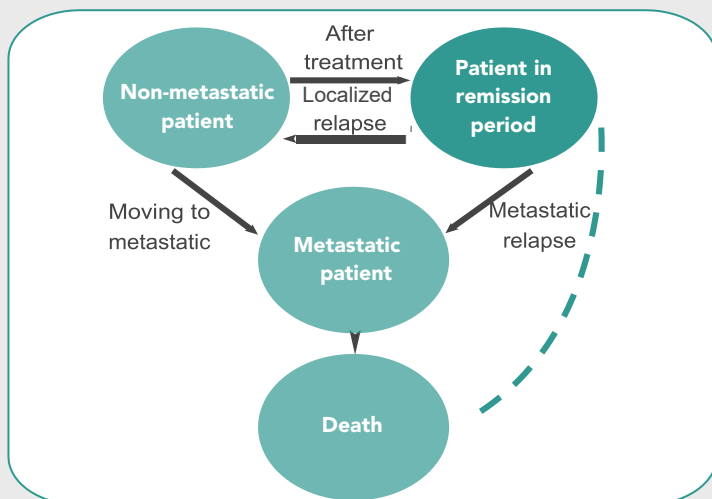
The SEER database provides information on patients at diagnosis. Since the follow-up information (i.e., vital status) is entered after diagnosis changes from non-metastatic to metastatic status is not updated in the database. As a result, a non-metastatic person who specifically died from thyroid cancer is considered to have necessarily relapsed to metastatic status during the observation period.

The purpose of the relapse model is to give the probability of patients moving from the non-metastatic to metastatic state, and then moving from metastatic to death.

In consequence, the survival curves will look more realistic - an insured person is a person who has not relapsed before the application.

In Brief

SCOR's new underwriting solution Vitae Thyroid Cancer provides underwriters with a useful tool to assess the mortality and relapse risks for individuals with a history of thyroid cancer based on classical and easy-to-retrieve risk factors such as age, histology, stage, regional lymph nodes, metastases, etc. Combining advanced actuarial methods, medical knowledge, and underwriting expertise, Vitae Thyroid Cancer stays updated with medical breakthroughs, constantly remodeling for underwriter needs in terms of day-to-day work outflow.

Don't hesitate to contact us for further information and to test out the tool.

References

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