



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

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Introduction and Context

Colon cancer is a cancer that develops from cells located on the inner wall of the colon. It is characterised by its location in the colon, its depth in the wall, the appearance of the cancer cells, the involvement of the nodes close to the colon, and the presence of metastasis in the neighboring organs. It is the **3rd most diagnosed cancer** worldwide, well gender balanced with 1,148,515 new cases diagnosed globally in 2020.

Advances in cancer screening make it possible to diagnose more patients at an early stage of disease. With the improvement of medical treatments, patients diagnosed at an early stage have a **more favorable prognosis and are more likely to respond to treatment**. This allows for a considerable increase of the patient's life increasing the prevalence of individuals with a background history of colon cancer. This represents a challenge for insurers because more and more long-time survivors are applying for insurance.

Defining the individual prognosis of a person with colon cancer to assess the risk of relapse and death is medically associated with several clinical and biological prognosis parameters that are used by doctors at diagnosis and can be found in medical records. The development of a more inclusive underwriting program for people with a colon cancer history **requires a very detailed knowledge of these prognostic parameters**. Moreover, with the recent advances in Machine Learning and the availability of specialised rich data, **the quality of predictions should improve significantly**.

This is the reason why we have developed **Vitae Colon 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 colon cancer based on a wide range of parameters that are good predictors of recurrence and death. This allows improved accuracy in estimating individualised risk assessment and underwriting.**

What Vitae Colon Cancer allows us to do?

AN UNDERWRITING SOLUTION TO ASSESS COLON CANCER CASES

Underwriting solutions such as Vitae Colon Cancer simplify the underwriter's work as it gathers all the information necessary to compute the risk on a specific, secure, and user-friendly web-based application. The following risk factors are considered when going through the application of a person with a history of colon cancer, but in remission:

- Current age
- Duration since diagnosis
- Stage (*depth of the tumour in the colon wall*)
- Grade (*appearance of the cancer cells compared to normal cells*)
- Regional lymph nodes (*involvement of the nodes close to the colon*)
- Metastasis (*spread of cancer cells from the colon to other organs: cancer relapse*)

The list above is crucial in terms of importance in the evaluation of the vital prognosis (a metastatic status being the riskier). Each variable has several modalities. There are over 5,000 possible combinations of these variables. This makes colon cancer one of the tumours for which a "multifactorial" risk-evaluation justifies the need for a new comprehensive tool. To facilitate risk assessment, a specially designed user interface guides underwriters through all the steps of the risk assessment, providing explanations for each risk factors. (AJCC Cancer Staging Manual (8th edition))

A CLEARLY DEFINED PERIMETER OF ACCEPTED TYPES OF COLON CANCER

Vitae Colon Cancer is built to assess the risk of most colon cancer cases. However, this underwriting solution can't propose cover for the riskiest cases. Some other impairments¹ should also be assessed using the specific rating grids in SOLEM, for these conditions. **For all other more frequently submitted cases, Vitae Colon Cancer empowers underwriters to assess risks and propose an outcome.**

ACCEPTANCE OF SOME METASTASIS CASES

Colon cancer is characterised by the appearance of a tumour in the colon. The cancerous cells present in the colon can spread to other organs such as lungs, brain, or liver. This spread is called metastasis and is characterised by a relapse of the cancer. The associated risks are very high and lead to uninsurable cases². However, in cases of 1 to 3 surgically resected metastases of the liver, **the long-term risks are significantly lower than other metastatic cases, some becoming comparable to cases without metastasis.** In many market areas, postponements may apply for several years following the diagnosis and insurance offers may be considered thereafter if no relapse has been observed. (Engstrand J, 2018) (Tomlinson JS, 2007) (Creasy JM, 2018)

1. Lymphoma, Soft tissue sarcoma, Carcinoid of the colon, Gastrointestinal stromal tumour (GIST), Carcinoma in situ - Colon

2. Metastatic disease (more than 3 resected metastases in the liver or other metastases elsewhere in the body), Melanoma



Vitae Colon Cancer is based on data and validated with medical expertise

THE SEER DATABASE PROVIDES A WEALTH OF INFORMATION ON COLON CANCER

The Vitae Colon Cancer algorithm was built using the SEER (Surveillance, Epidemiology and End Result) database. This American database has been collecting data since 1973. Today, SEER is the world's largest database specialised in cancer and recognised by the global medical and scientific community. More than 400,000 observations are

added every year. Biometric variables (age at diagnosis, etc.), medical variables (tumour size, tumour stage, etc.) or therapeutic variables (surgery, chemotherapy, etc.) are provided and this database makes it possible to monitor the vital state of the patient. (NIH, s.d.)

The following reasons have led us to select this database:

- **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, ensuring statistical power of results.
- **Representativity:** This database is representative of the American population in terms of socio-professional criteria. Some ponderation can be applied to adapt to another specific population around the world.

ADDITIONAL FEATURES AND REQUIREMENTS FOR VITAE COLON CANCER

To provide the most adapted tool for underwriters, the Vitae Colon Cancer was built to comply with several constraints:

1. Business

Variables must be easily available to insurance companies. This means that the variable must be readily available in **the insured's medical file at the time of application. The number of variables that the underwriter is required to fill in the tool shall remain reasonably limited.**

2. Commercial

The consistency of prices is a fundamental aspect for underwriters to justify loadings. **Rates must be consistent with medical discourse.** For example, if the medical literature indicates that an individual is more likely to survive with a submucosa invaded than with muscularis propria invaded tumour, then the fee should follow the same logic. In other words, the extra premium must be lower for an individual with a submucosa invaded than with a muscularis propria invaded.

3. Medical

The selected variables must also be considered as prognostic variables that are clearly identified by physicians and recognised as such by the medical literature.

4. Statistical

The chosen variables must have a high feature importance. In other words, elements included in the model **must have a significant impact on predictions.**

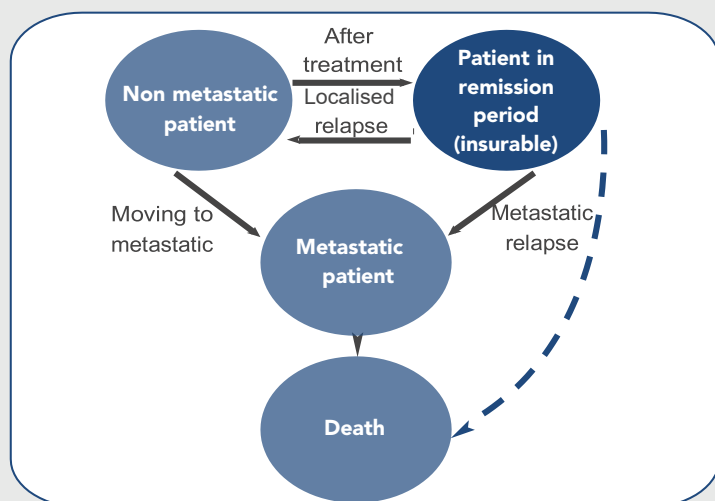
Estimation of the Colon Cancer mortality risk considering the risk of relapse

THE RISK OF RELAPSE

The pricing model behind the Vitae Colon Cancer considers the risk of relapse. The model calculates the extra premium of an applicant with a history of Colon Cancer, i.e., the extra mortality of this person. In other words, it is the same as determining the probability that this person with a relapse dies specifically from this disease. Probabilities of death estimated are used as the first step of the computation.

Having a comprehensive database is just a first step. To provide the fairest pricing, the model is based 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 colon cancer (or in remission) only dies from the cancer if he/she has metastasis (gone from non-metastatic to metastatic or metastatic relapse).
3. The longer the remission period, the lower the risk of relapse.



The SEER database provides information on patients at diagnosis. Only follow-up information (vital status) is entered after diagnosis. The change from non-metastatic to metastatic status is therefore not updated in the database. Therefore, a non-metastatic person who specifically dies of colon 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:

- Moving from the non-metastatic to metastatic state.
- Moving from metastatic to death.

Thus, the survival curves reflect more the insurance reality, an insured person is a person who has not relapsed before the application.

In Brief

The new underwriting solution Vitae Colon Cancer provides underwriters with a useful tool to assess the mortality and relapse risks for individuals with a history of colon cancer, based on associated risk factors (stage, grade, regional lymph nodes, metastases etc.). Combining actuarial methods, medical knowledge, and underwriting expertise, Vitae Colon Cancer is keeping up with medical breakthroughs and is constantly remodelling to underwriters needs in terms of day-to-day work.

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

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