Intermediary Report

Submitted to the SCOR Foundation for Science

Impact of the COVID-19 pandemic breast cancer: an application on breast cancer and critical illness insurance

Submitted by:

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Project Objectives

This project is related to results dissemination, knowledge exchange, and presentations to a larger audience of the ongoing research on `Estimating the impact of the COVID-19 pandemic on breast cancer - an application on breast cancer life insurance and critical illness insurance'. The Agreement was signed on 6 October 2022.

The main objectives of the related research are to

a) investigate how the COVID-19 pandemic, and its impact on the diagnosis of different stages of breast cancer (BC) morbidity, have affected BC mortality;
b) assess the implications of COVID-related changes to BC morbidity and mortality on related life and critical illness insurance (CII) products; and
c) disseminate the findings to a wider community, including academic and industry parties.

Schedule

The project was initially panned to end in October 2023. The duration of the project has now been extended until 9 October 2024 to facilitate further dissemination, communication, and knowledge exchange of project results. Accordingly, the researchers will inform the SCOR Foundation about the forthcoming dissemination events. The related presentations and the new research articles will be communicated with the SCOR Foundation and also posted on the SCOR Foundation website.

People

The project was carried out by the principal investigator (PI) Dr. Ayşe Arık and the co-investigator (co-I) Prof. George Streftaris in Department of Actuarial Mathematics and Statistics at Heriot-Watt University. The PI was the lead on all papers and presentations produced throughout the project. The PI collaborated with a number of people as listed follows:
1. Andrew J.G. Cairns
   Professor of Actuarial Mathematics, Department of Actuarial Mathematics and Statistics, Heriot-Watt University, UK
2. Erengul Dodd
   Professor of Actuarial Mathematics and Statistics, Mathematical Sciences, University of Southampton, UK
3. Angus S. Macdonald
   Professor of Actuarial Mathematics, Department of Actuarial Mathematics and Statistics, Heriot-Watt University
4. Adam Shao
   Biometric Risk Modelling Chapter, SCOR, Singapore

Summary of Project Objectives Completion

The following steps are completed in line with objective (a):

- We enhanced a new type of model to quantify the impact of the COVID-19 pandemic on BC mortality based on a Markov and semi-Markov modelling approach.
- The models were developed by considering pre-metastatic and metastatic BC for women at different ages. We used publicly available population data for England and published clinical studies while calibrating the model(s).
- Pre- and post-pandemic calibrations were carried out to quantify the short-term impact of the COVID-19 pandemic on BC risk. Two main pandemic scenarios were considered, particularly accounting for the increase in other cause mortality and the decline in cancer diagnoses in 2020.
- The implications of newly developed models were examined by implementing the models within the context of specific BC life and CII contracts.
- The earlier version of this part of our research, based on Markov model, was published as a conference monograph after the Living to 100 Symposium by the Society of Actuaries (SOA) [1].
- Furthermore, there is currently a research paper under review that covers the improved model, semi-Markov model, with further modelling results [2].

The following steps are completed in line with objective (b):

- We calculated net insurance premiums for a BC life insurance and CII contract based on the models developed under objective (a). Furthermore, comparisons were made using an industry based model as a baseline model.
- Main findings were obtained based on different modelling assumptions, using the available population data for different calendar years, with and without pandemic years.
- A research paper was prepared regarding this part of this project (currently under review) [3].

The following steps are completed in line with objective (c):

- An online presentation was given at the Living to 100 Symposium, Hong Kong on 16 February 2023 [4].
- An in-person presentation was given at the International Congress of Actuaries (ICA) 2023, Sydney, Australia, between 28 May and 1 June 2023 [5]. Research findings were disseminated in the IAA Council and Committee Meetings, between 24 May and 27 May 2023, in addition to the ICA 2023. Also, collaboration and network opportunities have been pursued with colleagues at the University of New South Wales (UNSW), e.g. Dr Andres Villegas, and Monash University in Melbourne, e.g. Dr Hamza Hanbali.
- An in-person presentation was given in Actuarial, Finance, Risk and Insurance Congress (AFRIC) 2023 in Victoria Falls, Zimbabwe, between 23 July and 28 July 2023 [6].
- An in-person presentation was given at the 18th Longevity Risk and Capital Markets Solutions Conference in London, UK, between 7 and 8 September 2023 [7].

- An in-person workshop was organised SCOR Foundation for Science to engage with the Biometric Risk Modelling Team and record promoting interviews, between 20 and 21 September 2023. Both the PI (AA) and the Co-I (GS) made in-person presentations.
- A webinar was organised by the SCOR Foundation for Science on 15 November 2023. Both the PI (AA) and the Co-I (GS) made an online presentation [8].

Summary of Main Findings

The main findings of this project are summarised as follows:

1. We developed a modelling framework for quantifying the impact of initial health disruptions caused by the COVID-19 pandemic on BC mortality. The model framework, relating to delays in the provision of BC diagnostic and treatment services, is based on a Markov approach in the absence of comprehensive data. The modelling framework is versatile and can be used to compare different health systems in different countries. It can also be applicable to various cancer types sharing similar characteristics with BC [1].

2. We calibrated a Markov and semi-Markov model based on publicly available population data in England and in related medical literature for ages between 65 and 89 years old. We quantified the impact of initial health disruptions caused by the COVID-19 pandemic on BC deaths and found

   o a 3-6% post-pandemic increase in the number of BC deaths over 5 years, for individuals aged between 65 and 89, as compared to the pre-pandemic calibration based on the semi-Markov, and

   o a 5-8% post-pandemic increase in the BC deaths over 5 years, based on the Markov model [2].

3. We demonstrated the significance of modelling the duration of time spent with pre-metastatic BC before developing metastatic BC, on BC deaths. This was achieved by using different Markov and semi-Markov modelling assumptions.

4. We investigated the implications of having different modelling assumptions on specific BC life insurance and CII policies. We demonstrated that our modelling framework is broadly in agreement with the empirical evidence related to net cancer survival from pre-metastatic or metastatic BC, and the proportion of BC deaths over all deaths. Comparisons were made with an industry-based model. Our findings suggest that the industry-based model should be approached with caution as it is sensitive to model assumptions, and it is not able to capture the relationship between age and BC survival in general [3].

References

[1] Arık, A., Cairns, A.J.D., Dodd, E., Macdonald, A., and Streftaris, G., Estimating the impact of the COVID-19 pandemic on breast cancer deaths among older women, 2023. https://researchportal.hw.ac.uk/en/publications/estimating-the-impact-of-the-covid-19-pandemic-on-breast-cancer-d

[2] Arık, A., Cairns, A.J.D., Dodd, E., Macdonald, A., and Streftaris, G., The effect of the COVID-19 health disruptions on breast cancer mortality for older women: a semi-Markov modelling approach, under review, https://arxiv.org/abs/2303.16573.

[3] Arık, A., Cairns, A.J.D., Dodd, E., Macdonald, A., Shao, A. and Streftaris, G., Insurance pricing for breast cancer under different multiple state models, under review.

[4] https://www.soa.org/prof-dev/events/2023-living-to-100-asia/

[5] https://www.actuaries.asn.au/microsites/ica2023/program/2023-program

[6] https://www.unsw.edu.au/business/our-schools/risk-actuarial/news-events/actuarial-finance-risk-and-insurance-congress

[7] https://www.bayes.city.ac.uk/faculties-and-research/centres/pensions-institute/events/longevity-18/longevity-18-parallel-sessions?SQ_DESIGN_NAME=print%3FSQ_DESIGN_NAME%3Dprint

[8] https://foundation.scor.com/news/scor-foundation-webinar-cancer-covid-19-and-inequalities