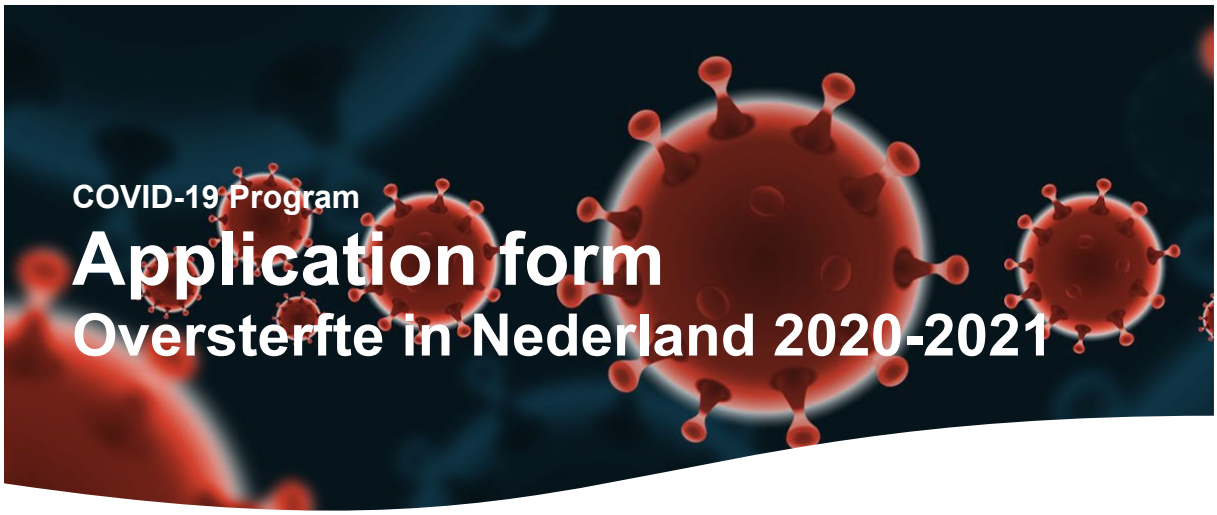


COVID-19 Program

Application form
Oversterfte in Nederland 2020-2021

Deadline for submission: 30 September, 2022 (14:00 AM)

Instructions:

1. Please read the call for proposals carefully before you start writing your proposal.

2. The proposal should be written according to the format on the next pages and should be written in English. Your application has a maximum of 10 pages, font size 10, excluding front page and references.

3. The proposal consists of the following parts:
    1. **Fill in all information in MijnZonMw** tabs, for example the title of your proposal and project group composition.
    2. **This application form**
    3. **Budget form**
    4. **Written motivation on your budget**
    5. **Optional:**
        - Attachment with figures and tables (1 A4 max.)
        - *If applicable: Letters of commitment of all co-financing partners (one per organisation)*

Submission of proposals (via MijnZonMw)
Proposals should be submitted online before **30 September 2022, 14:00 AM**. For technical assistance regarding MijnZonMw, please contact the servicedesk between 08.00-17.00 on +31 70 349 51 78 or by e-mail at servicedesk@zonmw.nl.

General information

1. Name of main applicant

Prof. dr. R. (Ronald) W.J. Meester

2. Project Title

The Effect of the Covid-19 Pandemic on Cancer Screening and Cancer-Related Mortality in The Netherlands in 2020 and 2021

3. Summary (for public use)

The Covid-19 pandemic has had a major impact on healthcare delivery worldwide. In The Netherlands, delayed care has led to significant losses in quality-adjusted life-years, including in cancer care. It is challenging to estimate the total effect of delayed referrals, diagnosis and treatment on morbidity and mortality. Recent research suggests that during the pandemic, the diagnosis of Stage I-II cancers significantly declined over a 12-month period while the diagnosis of Stage III-IV cancers increased. Late-stage cancer diagnosis has a direct effect on cancer related mortality, but it remains unclear to what extent delayed screening has impacted excess mortality in 2021 in The Netherlands.

The objective of this study is to estimate the effect of delayed cancer screening during the pandemic mortality for the three cancers for which screening exists in The Netherlands: breast, cervical and colorectal cancer on (excess) mortality. We will use 2019-2021 claims data to predict the probability of screening within the eligible population and mortality. Data will be analyzed using a two-stage residual inclusion model where Covid-19 in 2020 will be used to control for unobserved factors influencing both screening and mortality. Our study will analyze the proportion of deaths in 2021 caused by changes in cancer mortality due to the change in screening rates.

4. Keywords (max 5)

Delayed Care, Covid-19, Cancer Screening, Stage Shift and Distribution, Excess Mortality

5. Start date

01-12-2022

6. Duration of the project

6 months

Problem definition, objectives and relevance

1. Problem definition and objective

During the Covid-19 pandemic, delivery of routine care was sharply curtailed. This was due to both systemwide capacity constraints and policy decisions designed to preserve capacity for Covid-19 patients. In The Netherlands, delayed care affected various specialties and health outcomes, including cancer care. There have been several studies estimating the effect of delayed care on Quality Adjusted Life Years (QALYs), but early estimate of total QALYs lost during the first wave in March-August 2020 excluded potential increases in cancer mortality under the assumption that delayed care did not impact the care pathway or mortality rates. Yet, for most cancers, delayed care likely did have a direct effect on the tumor stage at diagnosis (2) changing the care pathway and probability of survival. In 2020 alone, there were about two thousand fewer complex cancer operations performed, a decrease of 11 percent compared to the two previous years[1]. It is unclear how this decrease affected health outcomes for these patients or how much of the decrease is due to changes in screening.

Previous research has found that, particularly in the fields of cancer and cardiac and heart disease, the effects of delayed care have been substantial and negative health effects are ongoing, impacting both morbidity and mortality. In The Netherlands, a recent study reported a significant negative impact of the COVID-19 pandemic on cardiac patient care emphasizing significant health damage and (extra) loss of life years in cardiology patients as a direct result of displacement of all cardiac care by preference given to COVID-19 care (8). Similar estimates are not yet available for cancer care and a direct link to the reported excess mortality in 2021 and beyond is lacking. The purpose of this proposal is to understand the effect of delays in routine cancer screening on cancer mortality.

Delayed Cancer Screening and Stage Distribution

The decreased number of interventions may be caused by delayed diagnoses, such as the temporary suspension of population screenings for breast, colorectal and cervical cancer. The number of referrals by general practitioners also decreased during the Covid-19 pandemic. Research from other countries suggests that delays in cancer screening and diagnosis affected stage distribution for several cancers, but it remains unclear to what extent delayed care has impacted excess cancer mortality, particularly in the short run.

In other countries, research shows a clear effect of delayed care during the pandemic on cancer outcomes. Data from the United States shows a reduction of up to 85% in overall cancer screening services at the height of the first wave (March–July 2020) (9). In England, urgent referrals for suspected cancer were down 16% (348,000 referrals) compared with data in the previous year (10). Internationally, cancer screening rates were reduced across all screening programs, across all ages and at all hospital care levels. The decreasing screening rates resulted in backlogs of cancer screening appointments. Disruptions of cancer screenings could lead to increase cancer disease incidence and prevalence, larger economic burden, increased workload for healthcare workers as they try to manage the backlogs of cancer screening schedules, and ultimately higher mortality rates (11).

Similar to the cause of reduction for other health care measures, reductions in cancer screening modalities- diagnostic imaging, histopathological and cytological biopsies- have been attributed to multiple causes. These include pandemic measures, such as stay-at-home orders; patients' fear of infection; hesitation to seek care; the perceived risk of exposure to COVID-19 for clinicians; changing hospital policies in re-deployment of staff towards critical care for the management of COVID-19 patients; and triage of patients with COVID-19 infection (12). In The Netherlands, a survey showed that about a third of respondents had delayed care because of surge capacity constraints (i.e.,

[1] Minder dan 500 coronapatiënten, maar crisis heeft grote impact gehad op kankerzorg (volkskrant.nl)

screening was not available because of the number of Covid-19 cases at their local hospital) and about a third did not go because of fear of Covid (13).

Regardless of the reason for the decrease in cancer screening and diagnosis, the impact of the reduction on morbidity and (excess) mortality in The Netherlands is unknown. Internationally, several studies have reported the effect on progressing tumors where the diagnosis of Stage I-II cancers significantly declined over a 12-month period during the pandemic while simultaneously the diagnosis of Stage III-IV cancers increased (14-15). In Italy estimated a significant increase in the total number of deaths from colorectal cancer (CRC) (+12.0%) when moving from a 0-3-months to a >12-month delay in screening, and a notable change in mortality distribution by stage when comparing the baseline with the >12-months. Other studies also show that later stage cancer diagnosis has a direct effect on cancer related mortality (15-19). In the UK it was reported that, due to the delay in accessing care from the pandemic, breast cancer mortalities will reportedly increase annually from 965 to 1028, annual lung cancer mortalities are estimated to increase from 18,443 to 19,855, colorectal cancer mortalities will increase annually from 5051 to 6078, and mortalities from esophageal cancer will increase from 3656 to 4034 (20). Similar patterns are likely in other countries, including the Netherlands.

Research in The Netherlands on the impact of screening is limited. On study examined the impact of COVID-19 and suspension of colorectal cancer (CRC) screening on incidence and stage distribution of colorectal cancers in the Netherlands (9). The authors concluded that the temporary suspension of the CRC screening program due to the COVID-19 pandemic will have a minimal long-term impact on stage distribution and CRC mortality, in contrast to research from other countries. This conclusion could be due to the use of cancer registry data, which only reports those who received screening among those who were diagnosed. The study reported a decrease as well as catch-up in CRC diagnoses during and after the suspension of the Dutch CRC screening program. The reduction was mainly limited to stage I CRCs and the authors wrote in their conclusion that they hope that the temporary suspension of the CRC screening program due to the COVID-19 pandemic will have a minimal long-term impact on stage distribution and CRC mortality. Thus, the exact effect of screening on mortality remains to be estimated. Also, similar estimates for breast and cervical cancer screening are needed since the reduction in screening was mostly observed for those cancers in 2020, not colorectal.

Effect of Delayed Cancer Diagnosis and Treatment on Morbidity and Mortality

Some studies have estimated the effect of Covid-19 related delays in cancer screening specifically on cancer morbidity and long term QALY losses. In the United Kingdom, a study estimated that delayed cancer screening caused a total of 8000 years of life lost for a six-month interruption in breast and colorectal cancer screening (21). Delays in cancer diagnosis would also lead to excess cancer mortality in the short run and would equal approximately 40,000 years of life lost in the UK (22). A recent study in the United States calculated that, other than personal reasons for delaying care, non-medical interventions that government put in place, such as lockdown policies, resulted in QALY losses due to deferred care (23) where an average excess mortality of 10% of the 1.8 million new cancer patients would lead to 180,000 excess deaths in the next 5 years with average QALY loss of 10.64, or 1,915,200 QALYs lost due to increased cancer mortality. Morbidity in terms of quality-adjusted life years is thus directly related to mortality, but more research is needed to estimate the effect and the time during which this effect takes place. Maringe et al (2020) did find for the UK that the Covid-19 impact of delayed diagnosis due to the Covid-19 measures over a 12-months duration led to an increase of 7.9-9.6% mortality among breast cancer patients within 5 years; a 15.3-16.6% increase in mortality among colon cancer patients, a 4.8-5.3% increase among lung cancer patients and a 5.8-6.0% increase among esophageal cancer (22).

Other than referrals and delayed cancer screenings, leading to progressing tumors, cancer treatment has also been delayed. Lai et al. (2020) report that in the United States there was a 45-66% decrease

in chemotherapy treatment due to Covid-19 related measures and a 70-89% decrease in referrals for screening (24). Cancers and childhood cancers therapies were delayed in both high-income countries (HICs) and low and middle income countries (LMICs) due to supply chain interruptions, reduced access to cancer therapies and staff shortages during the pandemic. Delays and interruptions in cancer therapies were reported in 60 studies in HICs and LMICs (25).

Delayed Cancer Care and Mortality in The Netherlands

In The Netherlands, it has been reported that delayed cancer diagnoses did not have a negative effect on the severity of diagnoses[2], but the exact effect on morbidity and mortality in 2021 and beyond remains unclear.

Objective

The objective of this study is to estimate the effect of delayed and deferred cancer screening during the pandemic on mortality for the three types of cancer which have routine screening protocols in The Netherlands: breast, cervical and colorectal cancer.

2. Feasibility

We have a strong team of quantitative researchers with experience working with similar data and building similar models. We will be working with established econometric models for the research we propose to do and we have programmed these (in STATA) before. We have worked with pilot data from previous years for different research projects to establish that the work can be done within the time frame of six months.

We will first analyse the available 2019 claims data and, once we have the 2020-2021 data, we will use the code we developed with the 2019 data to quickly add the new years. We will have tested the models and run appropriate statistical tests with the 2019 data. Considering the sample size resembling the eligible screening population, we will have sufficient statistical power to detect the effects decreases in screening on mortality.

It is challenging to do causal inference models and estimate the effect of delayed screening on mortality within the maximum budget allowable, but we believe our team has the appropriate experience and skillset to do the work within the timeframe with the limited budget. We will not be time-limited by ethical or legal concerns as we will work with fully de-identified data and appropriate approvals will not likely take much time. In the unlikely event we will not get 2021 claims data in time to finish the project within six months, we will report 2019 and 2020 analysis which will still yield publishable results. Diagnosis and treatment data have already been requested from the relevant organizations and data stewards.

Timeline

The PI and co-I will take responsibility for the project proceeding in a timely way, with appropriate manuscript and dissemination plan prepared.

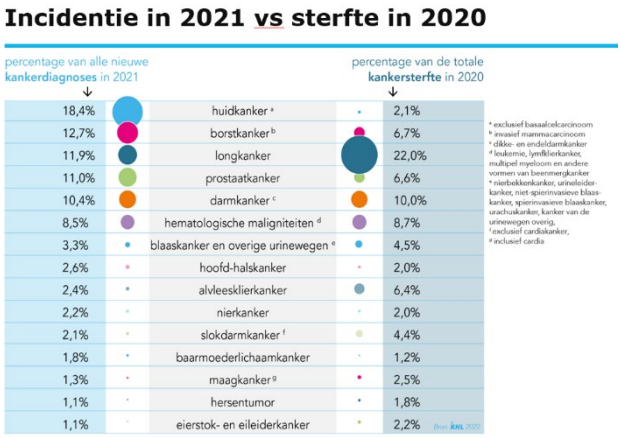
	Q1	Q2	Q3	Q4	Q5	Q6
Literature Review	x					
Data requests	x	x				
Building dataset		x	x	x		
Data Analysis			x	x	x	
Manuscript Preparation			x	x	x	x
Final Report and Dissemination of Findings						x

[2] Negatief effect vertraagde kankerdiagnoses lijkt mee te vallen (volkskrant.nl)

3. Relevance

It is challenging to measure an effect of Covid-19 related policies and health outcomes. Delays and deferrals in accessing care were due to a combination of increased fear of catching COVID-19 in the healthcare system, lockdowns, restricted public transportation and access to the healthcare centers, and hospital prioritization for patients with COVID-19. A survey in The Netherlands showed that, when asked whether someone had been confronted with a care delay due to the corona measures in 2020, 33 percent answered in the affirmative, 35 percent indicated that this had not been the case, the remaining group indicated that this did not apply (13). Accepting the fact we cannot isolate the "lockdown effect" or the "pandemic effect", we can do a better job estimating the total health impact of the decisions that were made in 2020-2021 regarding seeking or providing non-Covid care. Estimates of health consequences in the terms of QALY losses were estimated for surgical procedures that were postponed during the coronavirus pandemic (26,27), but the impact on mortality particularly in the short run remains unknown. With limited time and resources we cannot include all care and not even all cancer care in this study, but we can estimate the "pandemic effect" or "surge capacity effect" by analyzing the proportion of deaths in 2021 caused by changes in cancer mortality due to the change in screening rates.

In 2021, 44,996 patients in The Netherlands died of cancer [3], of which 3,100 were women with breast cancer, 213 were women with cervical cancer, and 2,074 were patients with colorectal cancer. For the latter, this number was almost 200 fewer patients than in 2020 and 200-400 less than the total number of deaths caused by colorectal cancer in any of the 15 years prior to 2021. The 15 years prior show deaths ranging between 2,238 and 2,569. Given that research has shown a significant impact of CRC screening on mortality (28), the mortality decline is highly counterintuitive. This may be due to overlap between susceptibility to CRC and to Covid-19 mortality. Indeed, in 2020, the World Health Organization (WHO) introduced a separate category of causes of death for this disease as a result of the corona pandemic, it is likely that some cancer patients which were likely going to die of cancer were reported as Covid-19 related deaths.



Source: IKNL

The purpose of this proposal is to understand if any proportion of excess mortality in 2021 can be explained by delayed cancer screening. Our study will examine how changes in screening for 1) breast cancer; 2) cervical cancer and 3) colorectal cancer have effects on mortality. The results of this study will be a comprehensive analysis of differences in screening effects on mortality. To do this, we will first review the existing literature to update our already developed two-stage residual inclusion models to identify the key predictors of screening and mortality. We will show how estimates differs between groups of patients that share observed characteristics.

Second, we will expand beyond the standard incidence studies to analyse causal effects of screening rates on mortality. Causal inference methods have the potential to inform health policy yet are underutilized. Instead, descriptive studies and reports of incidence now play a role in decision-making that affects individual patients and society as a whole. This represents an important missed opportunity for the research community, especially in the area of developing models to estimate the effect of surge capacity problems during the corona pandemic on health outcomes, particularly (excess) mortality.

[3] CBS (Centraal Bureau voor de Statistiek) Doodsoorzakenstatistiek

This project contributes to cancer care research by developing alternative approaches to predictions of screening and the effect of screening suspension on mortality. The key new contribution of this project is that it will analyze the proportion of deaths in 2021 caused by changes in cancer mortality due to the change in screening rates. The results of this study can be used to not only explain (excess) mortality in 2020 and 2021, but also to inform future healthcare decision-making around surge capacity and pandemic preparedness.

4. Approach

At its core, our proposal seeks to understand the implications of cancer screening suspension for different patient groups in the short run (<18 months). This is motivated by the idea that standard incidence studies do not accurately reflect the true incidence in the population and effects on short-run mortality. The lack of accuracy could be caused by:

a) incorrect data inputs to identify metastatic cancer (Aim 1),
b) limitations in epidemiological models to predict mortality (Aim 2), or;
c) problems in the ability or willingness of eligible populations to receive screening (Aim 3).

Our main hypothesis is that patients were more likely to die of cancer in 2021 than in the years prior due to delayed and suspended cancer screening due to the Covid-19 pandemic. Our proposed three aims will address the following research questions:

Research Question 1): Can we develop algorithms to identify metastatic cancer in the OpenDIS claims data?

OpenDIS contains information about Diagnosis-Treatment Combinations (DBC) originating from the DBC information system (DIS) of the Dutch Healthcare Authority (NZa). This public dataset contains data on all treatment trajectories in specialty care, from 2012 to the present[4] Most research focusing on the effects of screening on mortality and delayed screening on stage shifts uses tumor stage from oncology electronic medical record (EMR) data, often merged with cancer registry data or specific pathology data. We will develop algorithms for each cancer type using variables from the claims, including diagnoses, procedures, drugs, and oncologist visits. We will verify our candidate variables with one or more oncologists.

Research Question 2): What is the effect of the Covid-19 pandemic on cancer screening in The Netherlands and how did this impact (excess) mortality in 2021?

To answer this question, we will estimate and compare models where we will use estimates of 2019 screenings to predict the probability of death in 2020 and compare this to models estimating 2020 cancer screenings to predict the probability of death in 2021. By comparing the screened population to the eligible population that did not get screened, we will be able to control for factors other than the Covid-19 pandemic.

Research Question 3): What underlying factors explain reasons for non-attendance in cervical, colorectal and breast cancer screening.

Previous studies have focused exclusively on the screened population, but there is a body of literature on reasons for non-attendance and non-adherence to screening programs that may help explain other factors affecting screening rates. Data from the Integraal Kankercentrum Nederland (IKNL) shows that there are discrepancies in the percentage of the eligible populations screened and we will perform a review of the literature to help guide the quantitative analysis.

The overarching objective, as described, is to estimate the effect of delayed cancer screening on cancer mortality during the pandemic for the three cancers for which standardized screening exists in The Netherlands: breast, cervical and colorectal cancer on (excess) mortality.

[4] Nederlandse zorgautoriteit. OpenDIS 2022. Accessible at: https://opendisdata.nl/.

Research Population

Our target population is the eligible population for cancer screening.

Cervical Cancer Screening: For cervical cancer screening, the eligible population in The Netherlands is women between ages 30 and 60, approximately 4 million women[5]. In 2020, including women up to age 65, this was 49.7 percent of the female population in this age group which is lower than in previous years[6]. The COVID-19 pandemic is a potential explanation although it is unclear exactly which part of non-adherence is due to fear of Covid-19 and which part is due to delayed care. We do know that population screenings for cancer were temporarily suspended in the spring of 2020 and people were less likely to visit a doctor or general practitioner. We will compare the probability of screening in 2019, when it was approximately 56 percent of the eligible population, to 2020.

Colorectal Cancer Screening: For colorectal cancer, the eligible population is men and women between ages 55 and 75. This is approximately 4 million people of which 71.6 percent participated in screening in 2020. Compared to cervical cancer screening and breast cancer screening, the number of screenings did not significantly decline during the 2020 pandemic year.

Breast Cancer Screening: Approximately 3 million women are eligible for mammography between the ages 50 and 75. In 2020, 70,4 percent of women received mammography, where this number was 75,7 percent in 2021.

Data Sources

For our study, we will use claims data from OpenDIS which contains information about Diagnosis-Treatment Combinations (DBC) originating from the DBC information system (DIS) of the Dutch Healthcare Authority (NZa). We will use data for the years 2019, 2020 and 2021. The Central Bureau of Statistics (CBS) also has DBC-MSZ data from Vektis. This concerns the same data, but the Vektis data are more complete in terms of numbers of DBCs than the NZa data. DBC-MSZ also contains outpatient clinics and all MSZ institutions and it contains data on all performed procedures. We will request access to both OpenDIS and DBCMSZ where the 2020 data should be available for remote access and the DBCMSZ 2021 data is expected in Q1 of 2023.

Research Design and Data Analysis: 2-stage Residual Inclusion Models

The primary outcome in our quantitative analysis is mortality in 2021 while screening is a secondary outcome. Analytically, we will first estimate the probability of screening for cervical, colorectal and breast cancer in 2019, 2020 and 2021. Second, we will predict the probability of death based on screening in the year prior.

In our analytical model, the outcome Y = death from cancer in 2020 and 2021 and X_s = cancer screening. In our model, we will regress Y on X_s with the goal to estimate and draw inferences regarding the causal effect of the latter on the former. We will use a nonlinear regression specification because Y is binary. But our key analytical challenge is that X_s is likely to be endogenous – correlated with unobservable variates that are also correlated with Y. For example, unobserved family history may be correlated with screening and mortality – individuals knowing they are at higher risk than average (in ways that are not observable in the data) will be more likely to screen and more likely to develop and die from cancer. If the endogeneity of X_s is not explicitly accounted for in estimation, effects on Y due to the unobservables will be attributed to X_s and the regression results will not be causally interpretable and the coefficients of interest will be biased. In particular, a naïve model would underestimate the effectiveness of screening and thus the effect of care delays on mortality.

[5] https://www.cbs.nl/nl-nl/visualisaties/dashboard-bevolking/mannen-en-vrouwen
[6] https://www.staatvenz.nl/kerncijfers/baarmoederhalskanker-deelname-bevolkingsonderzoek

To address this issue, we will use an instrumental variable (IV) method for the identification and estimation of mortality in a two-stage residual inclusion model. In the generic version of the above model Y = dependent variable and the covariates include:

X_s = endogenous regressor (screening)
X_i = vector of observable exogenous (non-endogenous) regressors
X_u= unobservable variable that is correlated with X_s but not correlated with X_i. The presence of X_u in the model embodies the endogeneity of X_s. Following Terza et al. (2008) (29), we propose the following model:

$$Y = \mu (X_s, X_i, X_u ; \beta) + e$$
$$= \mu (X; \beta) \quad \text{(1) Outcome regression}$$
$$X_s = r (W; \alpha) + X_u \quad \text{(2) Auxiliary regression}$$

where β and α are the parameter vectors to be estimated and $W= [X_i\ W^+]$ where W^+ is a vector of identifying instrumental variables (IV) and μ( ) and r( ) are known functions and e is the random error term, defined as $e = Y - \mu (X;\beta)$ so that $E[e \mid X] =0$. The auxiliary regression specification in (2) implies that X_u can be written as the following function of W and α:

$$X_u (W ; \alpha) = X_s – r (W ; \alpha) \quad (3)$$

Given (3), an alternative and equivalent, representation of the outcome regression (1) is

$$Y = \mu (X_s , X_i, X_u (W ; \alpha); \beta) + e \quad (4)$$

The β parameters in expression (1) are not directly estimable, for example via a nonlinear least squares method because X_u is unobservable. Terza et al. (2008) ha shown that the following two-stage protocol is consistent where in the First Stage, we obtain a consistent estimate of α by applying non-linear least squares to (2) and compute the residual as the following estimated version of (3):

$$\hat{X}_u = X_s - r(W; \hat{\alpha}) \quad (5)$$

where $\hat{\alpha}$ is the first stage estimate of α and in the Second Stage, we consistently estimate β by applying nonlinear least squares to

$$Y = \mu (X_s , X_i, \hat{X}_u ; \beta) + e^{2SRI} \quad (6)$$

where e^{2SRI} denotes the regression error term that is not identical to e due to the replacement of X_u with the residual $\hat{X}_u$.

Applied to the cancer screening and mortality model we will use:

X_i [age gender race region severity] and, if data includes [education income smoking status]
W^+ [Covid-19 pandemic] where the regression model can be written as:

$$Y = exp (X_s\beta_s + X_i\beta_i + X_u\beta_u) + e$$
$$= exp (X\beta + e) \quad (7)$$

where and $\beta' = [\beta_s\ \beta'_i\ \beta_u]$. This way we will include a direct test of endogeneity as we specify the relevant auxiliary regression including the Covid-19 pandemic effect as the following version of equation (2):

$$X_s = exp(W \alpha) + X_u \quad (8)$$

In the First Stage we will consistently estimate α by applying nonlinear least squares to (8) and save the residuals as defined in (5). In this case

$$\hat{X}_u = X_s - exp(W\,\hat{\alpha}) \qquad (9)$$

where $\hat{\alpha}$ is the nonlinear least squares estimate of α.

We will estimate probit models for both 2019-2020 – using 2019 screening to predict 2020 morality – and also for 2020-2021 – using 2020 (Covid year) for 2021 mortality. This will allow us to estimate both changes in the probability of screening and changes in the probability of death, conditional on screening.

Project group and stakeholders

1. Project group

Dr. Ronald Meester is the Principal Investigator on this project. Associated with the VU University as professor of probability theory since 1998, his main research activities are in the field of forensic probability and statistics. He actively engages in the public debate about the scope and interpretation of (statistical) scientific claims and will guide the statistical modelling process of this project. The PI will will be joined by co-Investigators Dr. van den Broek-Altenburg and Dr. Adam Atherly.

Dr. van den Broek-Altenburg is trained as a Health Services Researcher, with cognates in Biostatistics, Epidemiology and Health Economics. She has over a decade and a half experience in health policy and healthcare decision-making in Europe and in the United States. She has developed expertise in evaluating the economic effects of healthcare interventions and programs; estimate healthcare spending; analyze patient choice; and model decisions in healthcare using discrete choice methods and advanced econometric models. She has also made contributions in further developing standardized quantitative measures to compare health systems and assess health system performance. She is an Assistant Professor and Vice Chair for Population Health in the Department of Radiology at the Larner College of Medicine at the University of Vermont (UVM) where she works on a range of projects related to recent policy reforms and effects of the Covid-19 pandemic in the State of Vermont. She also works as a consultant for U-Ridge Consulting Group.

Dr. Adam Atherly is a health economist and health services researcher in the Department of Health Administration at Virginia Commonwealth University in the United States. Dr. Atherly has more than 20 years of experience in healthcare research and evaluation. He has published more than 80 peer review journal articles and successfully completed research projects for funders ranging from the National Institutes for Health (NIH) and the Agency for Healthcare Quality and Research (AHRQ), to the Centers for Disease Control (CDC) to foundations and advocacy groups. Dr. Atherly regularly publishes in the top journals in Health Services Research and Public Health Systems and Services Research, including Health Services Research, Medical Care, Health Economics and others. He published more than ten papers in the last two years with Dr. van den Broek-Altenburg and others about the effects of the Covid-19 pandemic on health outcomes and healthcare delivery. He also offers his expertise as a consultant for U-Ridge Consulting Group.

The PI and Co-I's will be joined by a data analyst at the Amsterdam Health & Technology Institute. Through an extensive network of health and business professionals, Ahti helps payers, providers and entrepreneurs to develop solutions for better quality of care, higher patient satisfaction and more cost-efficiency. The data analyst joining this project has years of experience working with and analyzing the DBC-MSZ claims data and the CBS microdata for various health research projects.

2. Stakeholders

For this project, we will also be consulting a small panel of oncologists who will provide input on the claims data algorithms and variables included in the model. We will form an advisory committee (AC) that will include stakeholders from hospitals and the policy arena to inform, review and disseminate the results of the study. We already have commitments from key leaders in public health in The Netherlands.

Data management

1. Data management

For this project, we will use claims data from OpenDIS which contains information about Diagnosis-Treatment Combinations (DBC) originating from the DBC information system (DIS) of the Dutch Healthcare Authority (NZa). We will use data for the years 2019, 2020 and 2021.

We have requested permission to use the existing data and have met with representatives at NZa to discuss data elements needed. We will also request access to the microdata from the Central Bureau of Statistics (CBS) which also contains DBC-MSZ data from Vektis, depending on the data elements we will be able to secure from the NZa.

We have request access to 2019 and 2020 data which have been made available for remote access. The DBCMSZ 2021 data is expected in the first quarter of 2023 when we have started this project. We expect to have run preliminary models by the time the 2021 data becomes available and merging in more data will be straightforward.

We have set aside sufficient budget for the required data, taking into account potential costs for Vektis data if we need it and a fee to CBS.

Any data that is not stored at CBS will be stored at the Vrije Universiteit. The data from this study will be housed within this environment on prohibited systems, the most secure. Only those key personnel who need to see raw data for analysis will be given access to this folder. Aggregated results can be shared with other members of the study team where appropriate. Aggregated results will not be identifiable. All aggregated results needed for presentations or publications will be stored in folders with limited access on a shared drive. The study team has also considered to produce metadata for machines in our project.

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