

# Modelling informal caring behaviours in the Scottish population

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## Abstract

We present an agent-based simulation of social care provision in Scotland that simulates the behavioural processes underlying informal care provision, which accounts for 50% of social care provision in the country. Informal care is modelled as a negotiation process occurring in kinship networks, where agents will work in concert to provide care for those in need within their family. The result is a flexible model that enables the testing and evaluation of complex policy interventions. We demonstrate the model's flexibility with a proof-of-concept examination of the impact of lockdown policies linked to Covid-19 on social care provision.

## Introduction

Social care for the elderly population in the United Kingdom is an issue of significant policy importance. Numerous individuals require care on a daily basis for assistance with activities of daily living (ADLs), with increasing numbers over age 75 suffering from long-term limiting conditions (Age UK, 2017). As the elderly population continues to increase, and decreases in birthrate reduce the available population of carers (Coleman, 2002), the consequent rise in social care need leads to increased costs to public finances.

In the UK approximately 50% of social care provision comes from informal carers – individuals who provide care in their spare time for family members. Informal carers take on a substantial portion of the care burden in the UK, with their care contribution estimated at £100 billion/year (National Audit Office, 2018). Informal carers typically form carer networks of 3-5 members working in concert to address care needs within the family (Tennstedt et al., 1989). Despite these substantial contributions from informal carers, unmet social care need continues to increase; in 2017 an estimated 1.2 million elderly individuals received sufficient care (Age UK, 2017).

Below we present an agent-based model intended as a comprehensive platform for evaluating policies for improving social care provision. The model simulates informal caring behaviours in detail, allowing policy-makers to examine the potential impact of proposed policies on carers and their families. The model also simulates public- and

private-provided social care, and child care provision. We demonstrate the model by investigating the impact of Covid-19 containment strategies ('lockdowns') on social care need.

## Simulation functionality

This model is a variant of a previous model constructed to simulate social care provision in the UK (Gostoli, 2019), focussing on Scotland only. The simulation runs in Python in one-year time steps; simulations start in the year 1860 and run to 2050. Agents live on a 2D map of Scotland divided into local authority areas; local authorities control the eligibility criteria for Scotland's public-funded care system, in which eligible adults over age 65 are given free personal care. Agents have detailed life-courses: they can progress through education and into the workforce; form and dissolve partnerships; migrate domestically; change jobs; change their health or care-need status; and retire and draw their pension. In this paper we incorporate mortality rates of Covid-19 infected individuals by age and gender, and assume that in a lockdown scenario these rates do not apply as individuals are not infected. In a no-lockdown scenario, we assume the entire population is able to be infected.

Care provision is modelled as a negotiation process, in which agents within a kinship network divide informal care responsibilities amongst those with time availability. Care capacity is determined by the kinship network size, the closeness of kinship between members, and the status of each provider. Care need occurs in five levels of severity; progression between need levels is affected by age, socioeconomic status, and previous instances of unmet care need. This detailed representation of care provision and the mechanisms of informal care enable the model to simulate the impacts of social care policies on care-givers and receivers, while reflecting the diverse challenges encountered by informal carers.

## Results

Figure 1a shows the evolution of social care need in the period 1960-2050 in the benchmark scenario and the pandemic scenario (without any containment policy). The total amount

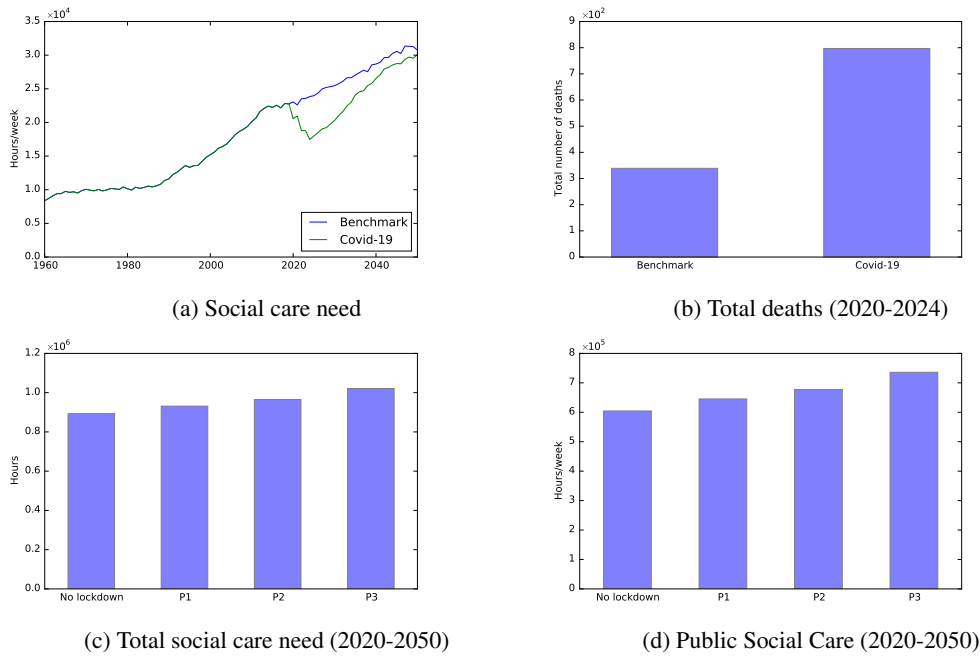


Figure 1: Comparisons of care need, cost and total deaths in baseline and Covid-19 lockdown scenarios

of social care need increases steadily from 1990, with a significant drop in the Covid-19 scenario from 2020. The decrease of social care need in the pandemic scenario is linked to the total number of deaths, as shown in Figure 1b. The absence of a containment policy leads to 160% higher deaths in the pandemic scenario over the benchmark scenario. Most of this increase consists of deaths of elderly people, who are also those with a high social care need.

The next two figures compare total social care need and publicly-funded care delivery in four lockdown policies under the Covid-19 scenario, in the period 2020-2050. We assume that the pandemic strikes in three waves: in 2020, in 2022 and in 2024. Under the first policy, no lockdown is implemented. Under Policy 1 (P1 in the charts), a total lockdown is implemented in 2020; under Policy 2 (P2) lockdowns are implemented in 2020 and 2022; under Policy 3 (P3) lockdowns are implemented in 2020, 2022 and 2024. Both the total social care need and public social care increase with the number of lockdowns. This suggests that the reduced virus-related deaths under lockdown lead to a subsequent increase in social care cost compared to the no-lockdown scenario.

### Model Limitations and Future Work

This model simulates detailed mechanisms of informal care provision, and as such is able to simulate the consequences of Covid-19 lockdown policies on social care need and cost. As the model evolves, we will progress from the current simplistic portrayal of Covid-19 spread to a more substantive epidemiological model. We will also address the current

model's temporal resolution; the model operates on yearly time steps, whereas Covid-19 can cause significant changes within a period of weeks or months.

The previous UK-wide version of the model was extensively calibrated using data on social care provision. The results demonstrated that our model could successfully reproduce the patterns of care provision observed across the UK, with appropriate proportions of care provided by informal, formal and private means. A similar calibration will be undertaken for this model using the more detailed data on informal and personal care available in Scotland.

Finally, we are acutely aware of the ethical considerations inherent in this kind of research, and we will present our work carefully and clearly contextualised. We wish to be clear that we do not suggest avoiding lockdowns and sacrificing the lives of vulnerable people to reduce social care costs; to the contrary, we intend for this model to make clear the costs in lives and population health of poorly-considered policy interventions in the social care sector during the pandemic.

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