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Making Minds Matter

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Spillover Effects of Delayed Nursing Home Admissions on Hospitalisations and Costs

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Abstract

We study spillovers of delayed nursing home admissions on urgent hospitalisations and costs in healthcare sectors in the Netherlands. We exploit plausibly exogenous variation in within-region congestion for admissions to nursing homes. A one-month delay increases urgent hospitalisation by 2.6 percentage points (15% of the baseline probability), mostly due to falls, and primarily driven by individuals with dementia living alone. Cost savings in nursing home care due to delays are largely offset by increased costs in home care and hospital sectors. These findings suggest that timely access to nursing homes can yield positive spillovers to other health care sectors.

Keywords— Nursing home care, Hospital care, Spillovers, Administrative data, Instrumental variable.

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1 Introduction

The rapid ageing of populations across OECD countries is placing increasing demands on informal and formal care for the older population and in particular the provision of nursing home care (Gruber and McGarry, 2023). A combination of increasing pressures on public spending on pensions and health and social care, a rising dependency ratio altering the structure of public financing, and greater demand for scarce health care workers threaten to disrupt timely access to nursing homes. Limited spare capacity in bed availability together with tight labour markets for care workers leads to excess demand requiring older frail individuals to wait longer for a nursing home place (Harootunian et al., 2023). Little is known, however, about the consequences of delayed access to nursing home care. Such information is crucial for policy makers when considering the optimal design and provision of care for their ageing populations. Delayed access to nursing homes is not only likely to impact eligible individuals via their health and well-being, but also has broader health system consequences through potential spillover effects impacting costs elsewhere in the health care sector.

This paper quantifies the consequences of delayed access to nursing home care driven by short-term fluctuations in waiting times for an admission. Such fluctuations can occur through random variation in the inflow of new residents and the outflow (deaths) of existing residents, even when, on average, supply and demand are in equilibrium (Leshno, 2022). These fluctuations are particularly likely in the nursing home context, as providers generally operate at (close to) maximum capacity (TNO, 2019) and the maximum number of nursing homes beds is fixed in the short-term (Ching et al., 2015; Gandhi, 2023; Hackmann et al., 2024).

We focus on the health effects to the individual of delayed nursing home access and on the broader spillover effects in terms of costs to other areas of the health care sector. First, we consider the effect that delays have on acute health shocks that lead to an urgent hospitalisation. Examples include hip fractures, heart attacks and strokes, which are frequent health events for older adults (Marks, 2010; Russo et al., 2011) leading to cognitive decline and loss of function (Schiele and Schmitz, 2023). Delays in access to a nursing home means that frail individuals have to spend a longer time in a home environment which might not be suited to their needs. A lack of sufficient supervision and inadequate circumstances like steep stairs and high doorsteps can lead to falls or other accidents (Crawford et al., 2021; Serrano-Alarcón et al., 2022) while waiting at home. On top of this direct effect on health, a lack of adequate care at home might also lead to a more rapid decline in chronic conditions and cognitive functioning, which in turn could lead to acute health shocks, not only while waiting for a nursing home bed but also after eventual admission.

Second, we estimate the effect of delayed access to nursing home care for costs of nursing home care, formal home care and hospital care. Delays in the access to a nursing home naturally leads to savings within the nursing home sector, but leads to expenses within other parts of health care. If delays in nursing home access indeed have acute negative effects on health, this causes increased expenditures for medical care, in particular for emergency and hospital care. Moreover, frail older individuals waiting for a spot in a nursing home will often receive nursing care and support with daily activities (e.g. bathing, cleaning) at home. These kinds of services are often publicly financed as part of a social long-term care insurances, provided by local authorities like municipalities, or subsidised by the national government.[1] A greater understanding of the cost spillovers from delays in nursing home access is important as countries around the world are stimulating 'ageing-in-place' and restricting access to nursing home care (Alders and Schut, 2019). This is especially relevant as the reimbursement of nursing home care, formal home care and hospital care is often delegated to separate payers (insurers, municipalities) that may mean that the benefits of care accrue to stakeholders other than those who bear the costs.

We use administrative data for the full population of the Netherlands on hospitalisations and nursing home admissions from 2015 to 2019. For each individual, we measure the duration of an individual's wait to be admitted to a nursing home, any hospitalisations within a year, and costs of nursing home care, formal home care and hospital care. To address non-random factors that impact delays, we adopt an instrumental variables approach. In line with Godøy et al. (2023), Hoe (2022) and Prudon (2023), we instrument an individual's delay, measured as the time between eligibility and nursing home entry, with the average delay (days of waiting) of other individuals with similar care needs who enter the waiting list for a nursing home admission within three months in the same region. Unlike structural mismatches between demand and supply, where we would expect selective changes in care-seeking behaviour on the demand-side affecting the composition of individuals who enter the waiting list, these short-term fluctuations are arguably uncorrelated with individual characteristics, and can thus be exploited to identify the (causal) effects of delayed access.

We find that delays to a nursing home admission lead to acute health shocks, which could have been prevented with more timely access. An additional one-month delay in a nursing home admission increases the probability of an urgent hospitalisation by 2.6 percentage points, which is equal to 15% of the urgent hospitalisation rate. This effect is mostly concentrated amongst individuals with dementia care needs and at least 30 percent of the effect is due to a fall. The health effect is likely explained by a longer exposure to an unsuitable home environment resulting in accidents and health shocks, rather than through a greater deterioration in chronic conditions and cognitive functioning.

We find substantial spillover effects of delayed admissions to nursing homes on costs for formal home care and hospital care. While delayed admission to a nursing home reduces individual-level costs related to nursing home care, it in-

[1] Examples are home care programs financed through taxes in Australia, premiums and taxes in the Netherlands and municipal taxes and national funding in Sweden (Barber et al., 2021).

creases costs of formal home care. Each additional month of wait, is associated, on average, with €1,942 of home care expenditures, equating to 42% of the cost of nursing home care. For the hospital sector, an additional month of wait leads, on average, to a €295 increase in hospital care expenditures as a consequence of additional hospitalisations and longer stays. Accordingly, while reducing delays to nursing homes has significant benefits to the health of individuals, the difference in total costs of receiving care at home versus a nursing home is modest relative to its health effects. The substantial health effects combined with modest differences in total costs suggests that encouraging individuals to receive care at home instead of in a nursing home – i.e. ageing in place – is not necessarily optimal from a societal perspective.

We contribute to three strands of literature. First, we contribute to the literature on spillover effects of long-term care on spending in other health care sectors by focusing on the effects of delayed access. Together with the use of co-payments, eligibility criteria, and budget allocations, the use of waiting lists to manage access is an important instrument for policy makers to ration long-term care use. However, the effects of delays as a rationing tool have not been studied yet. Related literature has studied the effects of other rationing measures; Gaughan et al. (2015) and Moura (2022) exploit regional variations in the supply of nursing home care in the United Kingdom and Portugal respectively and find that reduced supply leads to longer hospital stays. Costa-i Font and Vilaplana-Prieto (2022); Crawford et al. (2021); Forder (2009) exploit differences in public long-term care spending cuts or expansions across countries or regions on health care use and expenditures. Other studies use the introduction of long-term care insurance (Feng et al., 2020), changes in co-payments (Tenand et al., 2023) or variation in eligibility for long-term care insurance benefits (Bakx et al., 2020; Kim and Lim, 2015; Serrano-Alarcón et al., 2022) to study spillover effects. All of these studies find spillover effects of long-term care to hospitals.

Waiting is different from other rationing mechanisms in at least two respects. While other mechanisms entail at least a subset of affected individuals to forego nursing home care all together, fluctuations in delays involve (often relatively small) changes in the amount of nursing home care use, which potentially leads to different effects on health and costs. Moreover, whereas the prioritisation of future care recipients is decided by the national government through changes in the eligibility criteria and by the recipients themselves in case of co-payments, rationing through waiting times implicitly gives this responsibility to the providers. On the one hand, providers might be better at allocating nursing home beds to patients as they can use relevant and specific information about recipients that cannot be captured by general eligibility rules, such as the availability of informal carers, and they might be better at assessing care needs than individuals themselves (Finkelstein and Notowidigdo, 2019). On the other hand, providers can potentially misjudge recipients' care needs and are likely to prioritise the most financially beneficial recipients over those most in need of care (Gandhi, 2023; Hackmann et al., 2024).

Second, we contribute to the literature on the effects of waiting lists and delays in access to care. Prior studies (Moscelli et al., 2016; Nikolova et al., 2016; Reichert and Jacobs, 2018) have focused on how delayed access to a health care treatment affects the (direct) health outcomes of the treatment itself. Studies have, for instance, investigated the effects of delays for procedures such as coronary bypass surgery (Moscelli et al., 2016), hip replacement surgery (Nikolova et al., 2016) and psychosis treatments (Reichert and Jacobs, 2018) on health measured by mortality, re-admissions, or patient-reported outcomes after treatment ended. Instead, we focus on health events that occur during the wait in a different sector and their consequential spillover effects. Focusing on outcomes in other sectors is important for understanding the broader welfare consequences of waiting times. Recently, similar spillover effects have been studied by Godøy et al. (2023) and Prudon (2023) for orthopedic surgeries and mental health care respectively. However, they investigate spillover effects of waiting times focusing on labour outcomes. We extend this perspective to nursing home care, which seems a natural setting to do so: contrary to elective treatments, nursing home admissions generally are not aimed at treating a particular disease or impairment, but at providing a protective and supportive environment for individuals whose health will only further deteriorate. Most of the effects of delays are therefore likely to arise in other health care sectors rather than within the nursing home after admission.

Third, we contribute to the literature providing causal evidence on the health value produced by nursing homes. Several studies have recently exploited changes in nurse employment (Friedrich and Hackmann, 2021) and differences across nursing home care providers (Bär et al., 2022; Einav et al., 2021). We study the health benefits that nursing homes produce in comparison to care provided at home, such as protection against falls. Evidence from the medical literature, based on prospective cohort studies, shows that older people living in nursing homes are two to three times more likely to fall than those living at home (Rubenstein and Josephson, 2002; Shao et al., 2023). These studies compare between two populations – i.e. those receiving care at home vs those in a nursing home – who generally differ in terms of health and frailty. We contribute to this evidence by showing what would have happened if an individual would (randomly, via the use of an instrumental variable) receive care at home for a longer period, keeping differences in health and frailty constant. This is informative for policy makers considering whether investing in nursing homes is an effective way to reduce major health events. Our estimates suggest that, for a group of older individuals on the verge of being admitted to a nursing home, providing early access to nursing home care does prevent falls and other accidents.

2 Institutional context

Organisation and financing of formal long-term care in the Netherlands
Nursing home care in the Netherlands is organised and financed through the universal Long-term Care Act (in Dutch: Wet Langdurige Zorg). This care is

coordinated by regional single payers who contract providers and with whom they negotiate volume caps and reimbursed tariffs.

Nursing home care providers are private organisations. In the publicly financed market, these organisations are subject to regulation. For example, they should adhere to certain quality standards, and they are prohibited from making a profit (Bakx et al., 2021). There is a small, but increasing, number of for-profit providers in the privately financed market, which constitute less than 4 percent of the total nursing home population during our study period (Bos et al., 2020). Capacity is fixed in the short run, mainly because of workforce and real estate shortages (ACM, 2021). Providers receive a per diem rate, which is adjusted for the intensity of care, but not for the income or wealth of residents or other factors.

Individuals apply for insurance benefits at an independent agency. The main eligibility criterion is that the applicant requires round-the-clock supervision and/or care.[2] The agency decides i) whether the applicant meets the eligibility criteria; and ii) the intensity of care that the person is eligible to receive, which is referred to as a care profile.[3]

Recipients pay a relatively low co-payment, which is dependent on their income, wealth (Tenand et al., 2023) and whether they receive care in the nursing home or in their own home. The co-payment is not related to the provider or the price of care. This means that there are no price differences across providers for the care recipient.

Individuals who are eligible for long-term care insurance benefits can choose between receiving care in-kind or in-cash. In case of in-cash care, users receive a voucher to contract with a provider themselves (in Dutch: Persoonsgebonden Budget). Users of in-cash care never use their voucher for an admission to a regular nursing home in the publicly financed market because that would be financially unattractive. In case of in-kind care (93% of all eligible in 2020 (Statistics Netherlands, 2023c,b)), the costs are covered by the insurance and the regional purchasing office directly reimburses the provider based on the contracted price. Users of in-kind care do pay, as described above, a co-payment to the insurance.

Care received at home versus in the nursing home
In-kind care can be provided in a nursing home or at home (or another private setting). Some long-term care recipients choose to receive home care instead of going to a nursing home, but home care is also provided to (almost all) individuals who are on the waiting list for a nursing home, irrespective of their informal care arrangements.

Formal care at home is either provided as a single integrated care package

[2]The eligibility process is depicted in Appendix Figure A1.

[3]The decision should be exclusively driven by care needs, and hence not be affected by waiting lists (Bakx et al., 2021).

(in Dutch: Volledig Pakket Thuis) or per service (in Dutch: Modulair Pakket Thuis).[4] The care provided in the integrated package should be equivalent to the full care provided within the nursing home. However, in practice it is very difficult to provide the same round-the-clock intensive care that is available in a nursing home in someone's own house (or other private setting). The regional purchasing offices therefore normally opt for contracting the provision of specific services. These may involve regular visits by a care professional, washing and dressing and other daily tasks, depending on individual needs (SCP, 2019).

Generally the care at home financed through the long-term care insurance is complemented by care and services from two other schemes. Municipalities are responsible for adaptations of the house and the provision of medical aids like wheelchairs. The health insurer covers medical care, such as visits to the general practitioner, home nursing, hospital care and outpatient medication use.

Alternatively, in-kind care can be provided in a nursing home. In the Netherlands, nursing home care mainly refers to permanent stays in long-term institutionalised care facilities, which are medicalised and typically serve an older population with multiple and complex (mental) health conditions, such as heart disease and dementia (de Bienassis et al., 2020; SCP, 2021). Most primary and medical care services, except for hospital visits, are covered by registered (para)medical staff in nursing homes, such as registered nurses and doctors, which form 14 percent of the nursing home workforce (Bakx et al., 2023). The majority of nursing home residents in the Netherlands move permanently, implying that the vast majority of people who are admitted to a nursing home stay there for the remainder of their life (Bom, 2021).[5] The costs covered by the long-term care insurance for in-kind nursing home care include room and board.

Delays in access to nursing homes

People who are eligible to receive care paid for through the Long-term Care Act can choose any provider. Preferences for where to receive care - either at home or in a nursing home - and choice of provider are given to their regional care office, who can connect them to their preferred provider. If the recipient's preferred provider has no bed available (in the case of preference for receiving care in a nursing home), the recipient has two options: i) either temporarily receive in-kind care at home while waiting for an available bed; or ii) be immediately admitted to another nursing home. In both cases, they may be placed on the waiting list for a bed at their preferred location. If there are no beds available at any provider within the recipient's region of residence, an alternative provider located in a different region may be sought. In very few cases, no beds are available at all.[6] Some individuals may apply for eligibility out of precaution

[4] In 2017 approximately five thousand (50% of all individuals with an integrated care package) individuals use the integrated care package to receive nursing home care at a for-profit facilities and pay room and board out of pocket (Hussem et al., 2020).

[5] As in the United States, some nursing homes also provide short-term rehabilitation or post-acute care at separate departments or locations. This care is financed through another scheme which means we do not observe them in our data.

[6] Virtually all individuals on the wait list are waiting for a preferred provider during

and choose to wait and receive care in their own home, even if there is a bed available at their preferred provider.

Management of waiting lists for nursing homes
Waiting lists are managed by nursing home providers and monitored by the regional care offices. Nursing homes decide which recipients to admit based on the time of application and level of urgency (Hanning and van Vliet, 2016). The regional care offices monitor the waiting lists with a focus on preventing eligible individuals experiencing a very long waiting time. The maximum acceptable waiting time for nursing home care – set by a group of representatives consisting of care providers and insurers – during our study period was 1.5 months (NZa, 2021).[7] Most eligible individuals with an urgent admission could move to a nursing home within this period, but a considerable group chooses to wait longer for a preferred provider, for instance one that is located close to the individual's prior home (Bär et al., 2022).

3 Data

3.1 Data sources

We use administrative data at the individual level from Statistics Netherlands, which covers the full Dutch population. To identify delays in nursing home admissions, we link data on an individual's eligibility for a nursing home admission (including the first day of eligibility) from the Central assessment agency (CIZ - Centrum Indicatiestelling Zorg) to data on long-term care use from the Central administration office for long-term care insurance (CAK - Centraal Administratie Kantoor). We also link data on inpatient hospital admissions (including date and diagnoses) from all hospitals in the Netherlands from Dutch Hospital Data, and data used to control for background characteristics at baseline from mandatory municipal registries, health insurance claims and tax registries. Linkages are based on an exact match using (pseudonymised) identifiers for each individual. More information about the data and corresponding sources can be found in Appendix Table A1.

our study period. In January 2018, only 75 of the 10,228 individuals on the wait list are not waiting for a bed in a particular nursing home (Zorginstituut Nederland, 2018). Only 23 of these have been on the wait list for more than 1.5 months, indicating that there is usually a bed available at one of the providers.

[7] In 2021, given excess demand, this target became infeasible and the maximum wait has been increased to 6 months for individuals who want to be admitted to any provider, and to 12 months for individuals waiting for a preferred provider (Actiz, nd). In 2022, 11 percent of individuals on the waiting list waited longer than the maximum period of 12 months (Zorgverzekeraars Nederland, 2023).

3.2 Study population

The study population consists of individuals who became eligible to receive care in a nursing home between 1 April 2015 and 31 December 2018 which avoids measuring the outcome variables during the Covid-19 pandemic.[8] By focusing on individuals that have received an eligibility status, the study population consists of individuals requiring round-the-clock (24 hours) supervision or care.

We restrict the study population in seven ways (Appendix Table A2 provides exact numbers). First, we remove those who use the in-cash option of the long-term care insurance because they would never use their voucher for an admission to a regular nursing home.[9] Second, to create a homogeneous sample, we drop those who are less than 65 years old at eligibility. Third, we exclude those who delayed their admission by more than one year, as this likely reflects a strong preference to receive care at home instead of in a nursing home. Fourth, we drop individuals who received eligibility status while in hospital and those who already started incurring costs for long-term care before the eligibility assessment, since their admission process differs from those who receive eligibility status at home, and to limit the influence of hospital re-admissions. Fifth and most notably, to equalize the exposure to the hospitalisation risk to one year, we exclude 33 thousand individuals (29% of the initial sample) who died within one year following eligibility. We examine whether selection on survival affects our results in Section 5.6. Sixth, to focus on permanent nursing home admissions only, we exclude individuals if they (temporarily) moved out of the nursing home after their first admission and within one year following eligibility. Finally, we drop individuals with missing data on covariates. This results in a sample of 76,453 individuals, equal to 52 percent of all individuals eligible to receive nursing home care between 1 April 2015 and 31 December 2018.

3.3 Definitions

3.3.1 Care profiles

Because nursing home residents constitute a particularly heterogeneous group, our sample is split into three groups, defined by a care profile (in Dutch: Zorgzwaartepakket - ZZP). A care profile is set by the assessment agency when granting eligibility and reflects the individual's care needs. While formally there are no separate waiting lists, the allocation of nursing home beds is likely organised within care profiles, as they require different resources, such as a closed unit for people with dementia, and are therefore often divided over different departments.

[8] We restrict to 1 April 2015 to be able to construct the instrumental variable, which is based on people who were eligible up to 1.5 months before.

[9] The few individuals who utilise the in-kind scheme to receive care in a for-profit nursing home cannot be identified as such and they are therefore (mis)classified delaying their nursing home admission. If anything, we expect this would bias our results to zero, and our estimate would be an estimate of the lower bound of the true effect since these individuals may benefit from receiving care in a for-profit nursing home while they are reported to be waiting at home.

We use three care profiles that grant access to admission to a nursing home (see also Appendix Table A3).[10] First, we differentiate between those who require care for dementia or related conditions and those who require care for somatic reasons, such as physical impairments or multiple chronic illnesses requiring ongoing medical supervision. Then, among people with care needs for somatic reasons, we differentiate between those with moderate versus those with high care needs.[11]

3.3.2 Delayed nursing home admissions

We define the delay in admission to a nursing home as the number of days between the date at which the central assessment agency determines that an individual is eligible for admission to a nursing home and the (first) admission to the nursing home, as shown in Figure 1.[12] For example, if someone's eligibility decision is made on January 1 2017, and the individual starts incurring copayments for receiving nursing home care on July 1 2017, their delay is 181 days. We cannot observe whether an individual delays a nursing home admission because of preferences to receive care at home or because there is no capacity in their (preferred) nursing home facility. As further explained in Section 4.2, we solve this issue by using congestion, the average delay in a region at the time an individual becomes eligible, as an instrument. While the delay of individuals who want to move to a nursing home right-away is affected by congestion, the delay of individuals who want to stay at home in any case is not.

Figure 2 shows that the distributions of delays are right-skewed for all three care profiles: most people have no or short waits. While many individuals experience delays of less than 10 days (between 33% and 60%), a significant proportion (17% to 45%) have delays of more than 42 days (i.e. the maximum acceptable waiting time of 1.5 months during our study period). There is heterogeneity in delays across care profiles, with those with high somatic care needs having the shortest delays.

3.3.3 Urgent hospitalisations

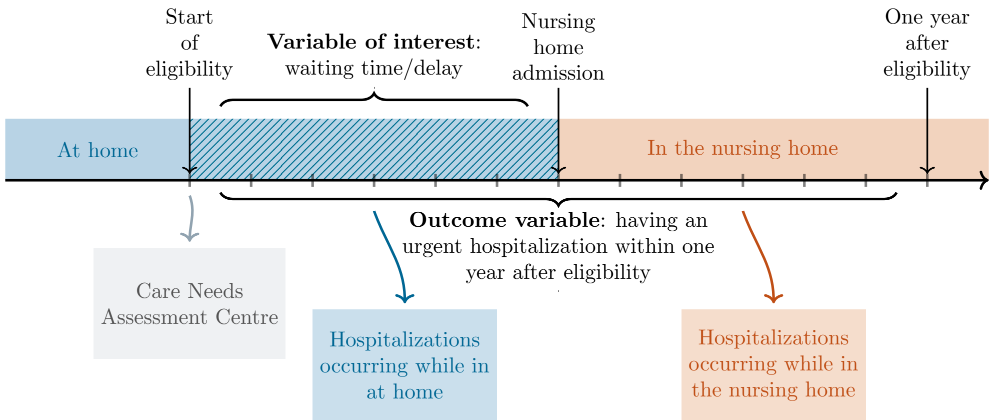
To measure the health effect of delaying a nursing home admission, we use the occurrence of an urgent hospitalisation due to an acute health shock. Being hospitalised at older ages is associated with reductions in an individual's quality of life (Karampampa et al., 2016), and functional and cognitive outcomes (Covinsky et al., 2003; Wilson et al., 2012). Focusing on hospitalisations that are urgent avoids the influence of individuals strategically timing their nursing

[10] Individuals eligible for rehabilitative or palliative care are excluded.

[11] We do not have a low-need group as all individuals who are granted eligibility require a minimum level of care needs.

[12] In practice, people can have multiple eligibility assessments, for example, when they require additional care and are assigned to another care profile. We focus only on an individual's first positive assessment.

Figure 1: Timeline for someone admitted to a nursing home six months after eligibility



Notes: The figure depicts an example of someone admitted to a nursing home within 6 months after eligibility. The figure shows that: i) delays to nursing home admissions are measured by the number of days between the start of eligibility to receive care in a nursing home and the admission to a nursing home; and ii) outcomes are measured over a one-year period after the start of eligibility, and can be observed either during the delay period at home or in the nursing home.

home admission because they anticipate a non-urgent hospitalisation, which is generally scheduled in advance.

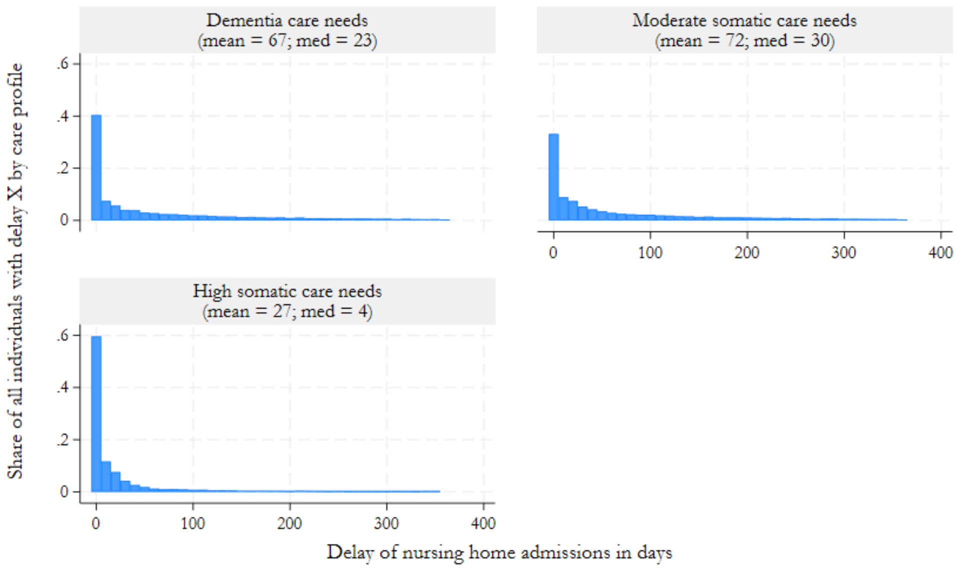
A hospital admission is classified as urgent if the treatment needs to occur within 24 hours following a physician's decision to hospitalise. More than 90 percent of urgent hospitalisations in the study population in 2018 are redirected from the emergency department.[13] The most common health shocks – as indicated by their (main) diagnoses for the first urgent hospitalisation – are: injuries to the hip and thigh (17%), heart disease (including heart failures) (9%), influenza and pneumonia (8%), disorders of the urinary system (including urinary tract infections) (7%), and cerebrovascular diseases (including stroke) (5%) (the 20 most common diagnoses are reported in Appendix Table A4).

When estimating the impact of delays to nursing home admission on urgent hospitalisation risk, we measure whether each individual in our sample had at least one urgent hospitalisation within one year following eligibility for nursing home care (see also Figure 1). Hospitalisations can occur while individuals are at their place of residence or already at the nursing home. This implies that for most individuals, the period covers both the time spent at home while waiting for a place in the nursing home, and the time spent in the nursing home since admission to the nursing home.

In addition to the probability of an urgent hospitalisation, we estimate the effect

[13] We only observe information on re-directions from the emergency department in the year 2018.

Figure 2: Distribution of delays in nursing home admissions by care profile



Notes: The figure shows the distribution of delays by care profile. The x-axis represents the number of days of delay for a nursing home admission in bins of 10 days. The y-axis represents the share of all individuals with the specific care profile that delayed by the number of days within each of the bins.

of delays on three types of other hospitalisation-related outcomes, and mortality. First, as a placebo test, we estimate the effect of delays on the probability of any, and non-urgent hospitalisations (see Appendix Table A4 for a list of most common diagnoses). Second, we use the probability of an urgent hospitalisation resulting from a fall as a separate outcome, defined using the hospital visit's secondary diagnosis (i.e. ICD-10 codes W00-19). We focus on falls because we expect its probability of occurrence to be particularly affected by delayed access to a nursing home (because falls are mainly affected by the environment in which one resides (Rubenstein, 2006)) and because its consequences, such as hip fractures, have large negative impacts on quality of life (Karampampa et al., 2016). The five most common diagnoses linked to falls are: injuries to the hip and thigh (59%), injuries to the head (12%), injuries to the abdomen, lower back, lumbar spine and pelvis (5%), injuries to the shoulder and upper arm (3%) and injuries to the thorax (2%). 23% of all urgent hospitalisations are linked to a fall. Third, we examine the total number of days spent in the hospital (for urgent reasons), which is the sum of the length of stay of all urgent hospitalisations within the year following eligibility. We examine this outcome both unconditional and conditional on having any urgent hospitalisation in the year following eligibility. Finally, we study mortality in the 12-18 months and 12-24 months after eligibility for nursing home care.

3.3.4 Costs spillovers

Costs for nursing home and home care
Delayed nursing home admissions can reduce or increase expenditures within the long-term care sector. Expenditures on long-term care are measured at the individual level in the year following eligibility and can be subdivided into expenditure on care provided by nursing homes and expenditure on formal care received at home while waiting for a nursing home bed. In the registry data, we observe the costs that are reimbursed from the insurer (i.e. regional care office) to the provider. For nursing home care and users who receive an integrated package of home care, this is a per diem price, summed over the number of days during which they receive care.[14] For users who receive care at home per service, we measure the sum of costs of all services in the year following eligibility (see also Appendix Figure A2 for the costs per service category).

Costs for hospital care
Given that we focus on the effect of delayed admission to nursing homes on urgent hospitalisations, we also measure hospital care expenditure in the year following eligibility. We do not observe these expenditures directly in our data, but measure them by multiplying the number of days spent in the hospital in the year following eligibility, which is one of our outcomes, by the average costs of an in-hospital patient day (€483), and adding the (main) diagnosis specific average treatment costs (see also Appendix A.2 for a more detailed description).

3.3.5 Control variables

We include a set of measures of an individual's underlying health and living situation upon eligibility. Table A1 provides a full overview of all control variables and definitions.

To control for demographics, we include sex and age at eligibility (in 5-year age groups). To further control for need or severity, we use information on the individual's care profile and prior care utilisation. These include: i) the eligibility profile of either dementia, moderate somatic needs or high somatic care needs; ii) healthcare expenditures for primary and hospital care services covered by the basic health insurance package in the calendar year prior to eligibility for nursing home care (i.e. defined at the start of our observation period); iii) an indicator for whether an individual was hospitalized in the month before eligibility; iv) 17 dummies for Charlson co-morbidities (see also Sundararajan et al. 2004), based on diagnoses following a hospital visit in the year prior to eligibility; v) 18 dummies for relevant types of medicines consumed in the calendar year prior to eligibility, selected using the Lasso[15]; and vi) an indicator for whether someone became eligible during the flu season.

[14] Because the per diem price for nursing home care also includes housing, while those for care at home do not, we subtract €710 per month from the nursing home price proportionally to the share of the month spent in a nursing home. This amount equals the maximum rent that falls within the bounds of social housing.

[15] Selected from a linear model with the urgent hospitalisation outcome as the depen-

Table 1: Descriptive statistics of study sample, total and by care profile

	Full sample		By care need profile					
			Dementia		Moderate somatic		High somatic	
	mean	sd	mean	sd	mean	sd	mean	sd
Outcomes in year after eligibility:								
Urgent hospitalisation (%)	17.1		12.6		23.2		18.2	
Non-urgent hospitalisation (%)	5.9		3.4		8.0		9.2	
Urgent hospitalisation - fall (%)	5.1		5.1		6.0		2.8	
Urgent hospital days	1.5	5.0	1.0	4.1	2.1	5.8	1.7	5.5
Variable of interest:								
Delays (in days)	61.9	87.4	67.2	90.6	71.7	90.8	27.2	57.8
Instrumental variable:								
Within region and care profile variation in delays (in days) congestion	53.5	23.3	57.3	17.8	63.9	21.5	21.9	9.1
Covariates (excl. 18 medication and 17 Charlson comorbidity dummies)								
Women (%)	68.5		66.9		72.4		65.7	
Age-group (%)								
65-69 years	3.3		3.4		2.0		5.4	
70-74 years	7.4		8.5		4.8		9.6	
75-79 years	14.6		16.6		11.5		14.9	
80-84 years	25.2		27.0		23.8		22.6	
85-89 years	29.0		28.2		32.4		24.6	
90-94 years	16.4		13.5		20.3		17.3	
95+ years	4.0		2.7		5.0		5.6	
Healthcare exp. on GP care (x1000€)	0.4	0.2	0.3	0.2	0.4	0.3	0.4	0.3
Healthcare exp. on hospital care (x1000€)	3.7	8.2	2.5	5.5	4.0	8.1	6.3	12.9
Hospitalisation in last 30 days	4.3		3.4		4.5		6.7	
Wealth (%)								
<€5,000	21.3		20.1		22.2		23.0	
€5,000-€20,000	25.9		24.7		28.2		25.0	
€20,000-€50,000	24.0		24.3		24.3		22.7	
>€50,000	28.7		30.9		25.2		29.3	
Home ownership (%)	34.4		38.2		28.9		34.3	
Eligibility in flu season (%)	29.8		30.3		29.0		29.6	
Living alone upon eligibility (%)	62.7		55.5		73.5		62.3	
Neighbourhood: urbanity (x100 addresses)	17.3	13.5	17.3	13.4	17.4	13.5	17.1	13.5
Neighbourhood: share of population aged $\geq$ 65 years (%)	1.0	0.6	0.9	0.6	0.9	0.6	1.0	0.6
Neighbourhood: average distance to GP	21.1	5.8	21.1	5.8	21.2	5.9	21.1	5.8
Year of eligibility (%)								
2015	16.2		16.9		15.5		15.2	
2016	24.2		24.8		24.1		22.6	
2017	27.9		27.4		27.9		29.5	
2018	31.7		30.9		32.5		32.6	
Observations	76,453		37,803		25,666		12,984	
(%)	100		49.4		33.6		17.0	

Table reports mean and standard deviation of relevant outcomes and characteristics of the full sample and for each care profile separately. Variable definitions are reported in Appendix Table A1.

Furthermore, we include the individual's household wealth (excluding housing wealth) in the calendar year before eligibility, whether the individual was a house owner, whether the individual lived alone or with someone else (most likely a spouse) upon eligibility and three characteristics of the neighbourhood in which the individual lived upon eligibility: a measure of urbanity, the share of the population aged 65 and above and the average geographical distance from a general practitioner.

Finally, we include year and regional fixed effects to account for differences across (larger) regions and years that could affect delayed admissions to nursing homes and hospital care use, for example, the supply of nurses. Regions are distributed over 31 regional care office areas within which long-term care is purchased and organised.[16] They vary in terms of size and demographics: population sizes range from 180 thousand to 1.3 million and proportions of 65 year-old of the region's total population range from 13 to 24 percent (Statistics Netherlands, 2023a). Consequently, they face different levels of demand and supply for long-term care and therefore different levels of delays for nursing home admissions (see also Appendix Figure A3 and Appendix Table A5). For example, individuals with dementia care needs in the northern regions have on average substantially shorter delays (35 days), compared to some of the south-eastern regions (up to 100 days) (see NZa 2021 for a further discussion of differences in long-term care across regions).

3.4 Descriptive statistics

Table 1 presents descriptive statistics for the full study population and separately by care profile. Across the whole sample, 17% are urgently hospitalised due to a health shock within the year after eligibility. The average delay is 62 days. 69% are women, 54% are between 80 and 89 years old, 4% had a hospitalisation in the 30 days prior to eligibility. On average, individuals in the sample incurred €3,700 on hospital expenditures and €400 on care provided by general practitioners in the calendar year prior to eligibility. About 34% of the sample owned a house in the calendar year prior to eligibility and the majority (63%) lived alone upon eligibility. 30% received the eligibility status for nursing home care during the flu season, and the largest proportion of the sample (32%) was observed in the year 2018 (note that the first three months of the year 2015 are excluded).

dent variable and all 3-digit ATC-codes as explanatory variables.

[16] Virtually all individuals choose a nursing home within the same care office area in which they lived prior to the admission.

4 Empirical strategy

4.1 Estimation model

We estimate the consequences of delaying a nursing home admission using the following linear (probability) model:[17]

$$H_{irp} = \beta D_{irp} + X_i\gamma + \nu_r + \varrho_p + \varepsilon_{irp}, \tag{1}$$

where H_{irp} is the outcome for individual i in region r with care profile p. D_{irp} is the number of days an individual's nursing home admission was delayed. We include a vector of individual level health-related controls X_i (reported in Section 3.3.5), care profile fixed effects ϱ_p to capture part of the relationship between delays and the outcome that is driven by the individual's care needs at baseline, and region fixed effects ν_r that capture part of the relationship between delays and the outcome that is driven by the individual's region of residence, such as labour supply. ε_{irp} is an idiosyncratic error term.

To interpret the estimate, $\hat{\beta}$, as the causal impact of delaying a nursing home admission on the risk of being hospitalised, delays should be exogenous to other (unobserved) factors determining urgent hospital use. We identify three possible threats to identification. First, on the demand-side, healthier individuals may be more inclined to postpone their admission because there is less urgency to be admitted and they may prefer to receive care at home, rather than in a nursing home. In that case, both delays and the risk of hospitalisation may be influenced by the underlying health of an individual. We expect nursing home admissions to be more urgent for individuals who are most ill. Second, on the supply-side, providers may give priority to the most severely ill, resulting in shorter delays for this group. Third, while delays in nursing home admissions may impact hospitalisations, hospitalisations may also impact delays because it might allow individuals to skip the queue. If someone is hospitalised and is assessed to be too frail to return home, they are put on an urgent waiting list to be admitted to an available nursing home as soon as possible (Zorgverzekeraars Nederland, 2023). A hospitalisation while waiting for a nursing home is likely to lead to a shorter waiting time, which would bias $\hat{\beta}$ downwards.

4.2 Instrumental variable

To account for potential endogeneity of the delay in nursing home admission, we follow Bensnes (2021), Godøy et al. (2023), Hoe (2022) and Prudon (2023) by exploiting plausibly quasi-random variation in congestion within regional markets

[17] While our main measure of outcome, hospitalisation, is binary, we prefer to specify the model as a linear probability model (LPM) to enable the use of two-stage least squares estimation to deal with the potential endogeneity of nursing home delay. Given the proportion of hospitalisations recorded does not fall close to 0 or 1 (the proportion of urgent hospitalisations range from 0.13 (dementia care needs sample) to 0.23 (moderate somatic care needs sample) - see Table 1 - and that sample sizes are large, estimates from a LPM should be close to those from a probit model.

over time in an instrumental variable analysis. We define waiting list congestion C_{irp} as the average delay (D_j) across all other individuals $j = 1, \ldots, J_{irp}, (j \neq i)$, who became eligible in the time window starting 46 days before and ending 46 days after individual i's eligibility commenced, and who reside in the same region, r, and have the same care profile, p, as individual i. Individual $i's$ own delay is excluded from the computation of C_{irp} as follows:

$$C_{irp} = \frac{1}{J_{irp}} \sum_{j=1(j \neq i)}^{J_{irp}} D_j. \tag{2}$$

The level of congestion varies by the timing of eligibility, region of residence, and the care profile to which individual i belongs.

To obtain the causal impact of a delay to a nursing home admission on the outcomes, we estimate Equation (1) by two-stage least squares (2SLS) with robust standard errors. The first stage exploits within-region variation in congestion by care profile as an instrumental variable. By including region (ν_r) and care profile fixed effects (ϱ_p) in the first and second stage, we control for time-invariant unobserved differences between regions and care profiles in delays and the outcomes, as outlined in Section 3.3.

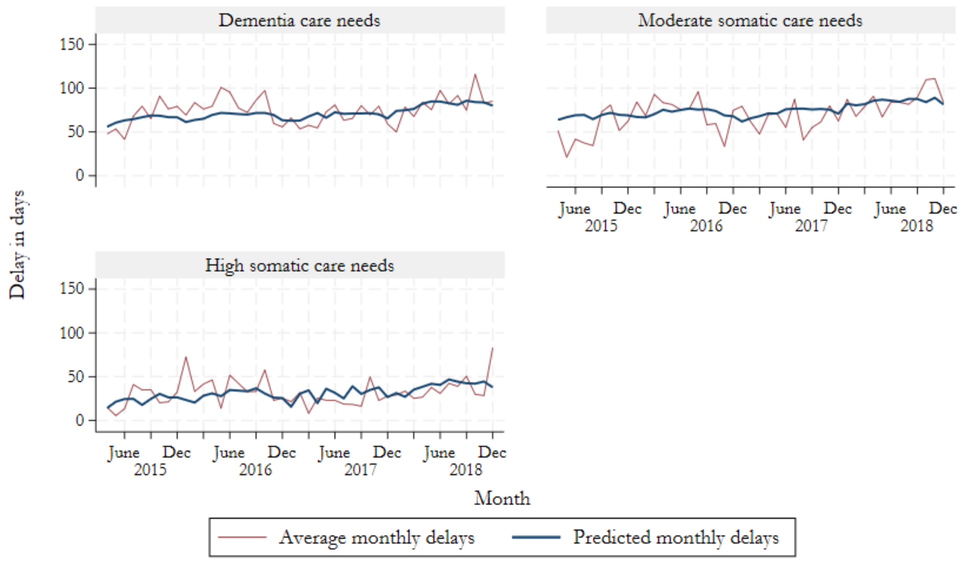
4.3 Assessing the instrument

Interpretation of the instrument

Figure 3 depicts how the level of congestion varies by the month of eligibility for the largest region in our sample, Utrecht, categorised by care profile. The red line represents average delays per calendar month, calculated over all individuals in Utrecht who receive their eligibility status during the respective month. Because our main specification includes a set of covariates, we also plot the expected delays for each month based on the observed characteristics of individuals who became eligible for nursing home care in each month. The differences between the red (actual average monthly delay) and the blue line (expected/predicted monthly delay based on background characteristics) illustrates the variation in congestion that is unexplained by observed individual characteristics, which serves as the basis for identification.

Figure 3 demonstrates substantial variation in congestion over time for each care profile. This variation in congestion can be driven by (quasi-) random shocks in nursing home care supply and demand that do not affect hospitalisations. For instance, congestion is expected to be lower after a new nursing home facility enters the market, and higher if increasing salaries in other sectors create staff shortages in the nursing home market. In practice however, supply of nursing home care is rather inflexible and we expect that congestion is mainly driven by the demand side, resulting from more eligibility applications in certain periods as compared to others. Illustratively, Appendix Figure A4 shows a positive

Figure 3: Average and predicted delays for largest region in the sample



Notes: The figure shows the actual average monthly delays (red thin line) and expected average monthly delays (blue thick line) by care profile for the region with the largest sample (Utrecht). Expected delays are predicted at the individual level using the coefficients of a regression with delays as a dependent variable and all covariates, year and influenza season fixed effects. Predictions are then averaged over regions and care profiles.

association between the instrument (i.e. average delays of individuals who became eligible within the same care profile, in the same region and period as the individual in question) and the number of individuals who became eligible for the same care profile, in the same region and period as the individual, accounting for covariates, as well as region, care profile and year fixed effects. This positive correlation suggests that the variation in the instrument is responsive to fluctuations in the inflow of new prospective nursing home residents, driven by (arguably random) shocks in the demand for nursing home care (Bakx and Wouterse, 2021).

Assessing the instrumental variable assumptions
We argue that our instrument satisfies the assumptions required to obtain a causal interpretation of delays on urgent hospitalisation by considering its relevance, validity and monotonicity.

Relevance
Table 2 reports the first-stage results from 2SLS that provide support that variation in congestion strongly predicts individual level delays. Individuals who become eligible to receive nursing home care in a period in which the average delay (i.e. congestion) in their region for their care profile is one day longer on

average wait 0.51 days longer to be admitted to a nursing home. The F-statistic to test the null hypothesis that the instrument has no effect on delays is large at 343 for the full sample estimates.[18] We compare this to the Montiel Olea and Pflueger (2013) critical value, which in our case, is 37.4 for a maximum bias of 5 percent, or 23.1 for a maximum bias of 10 percent. Clearly the instrument is relevant.[19] While the value of the F-statistic is lower when considering analysis by care profile, they remain sufficiently high for the dementia and moderate somatic care needs profiles to mitigate concerns over weak instruments.

Table 2: The effect of congestion on delays in nursing home admissions

		By care profile		
	Full sample	Dementia care needs	Moderate somatic care needs	High somatic care needs
	(1)	(2)	(3)	(4)
Instrument: congestion	0.510***	0.368***	0.330***	0.0872
	(0.0276)	(0.0500)	(0.0489)	(0.0765)
F-statistic	342.6	54.03	45.70	1.299
Care profile fixed effects	Yes	No	No	No
Observations	76,453	37,803	25,666	12,984
Mean dept. var	61.9	57.3	63.9	21.9

Table reports the first stage results. Second stage results are reported in Table 3. All models include all covariates and year, region and care profile fixed effects. The reported F-statistic denotes the effective F statistic on the excluded instrument (see also Footnote 18).

Robust standard errors between brackets. *** Statistically significantly different from zero at 1 percent; ** at 5 percent; * at 10 percent.

Validity

As explained above, variation in the level of nursing home congestion can be driven by the supply and demand side. While we expect that variation in congestion is mainly driven by demand-side factors, we cannot rule out that shocks to the local care economy may not only impact nursing home congestion, but also hospital capacity and the supply of formal care at home. For example, a (sudden) shortage in nurse labour supply, could cause shocks in the hospital sector or affect the supply of formal care provided at home. If this would result in reduced care use it would violate the independence assumption. Nonetheless, we expect these examples to be of little influence for the following two reasons.[20]

[18] We report the effective F-statistic which is robust to heteroskedasticity.

[19] The full sample the F-statistic is also larger than the value suggested by Lee et al. (2022) - an F-statistic as large as 105 to ensure a test with significance level 0.05.

[20] The independence assumption would also be violated if there are specific time periods in the year in which congestion is especially high or low in both nursing homes and hospitals, such as in December or in the flu season. We therefore include becoming eligible during the flu season as an additional control, and include month-by-year fixed effects as a sensitivity test.

First, hospital capacity constraints are not likely to affect our outcomes because these constraints are less relevant for hospitalisations that are urgent. While we cannot formally test this, we show that, within years, region and care profiles, average monthly delays are not correlated with urgent hospitalisations among the full population of individuals aged 65 years and over (Appendix Table A7). This suggests that shocks affecting congestion in the nursing home market do not affect hospital care utilisation in general.

Second, the supply of formal care at home is likely less affected by local and temporary capacity constraints because home care use does not depend on the availability of a physical space or bed. To check the validity of this argument, we look at fluctuations in the intensive margin of formal home care provision.[21] If individuals receive less formal home care during times of congestion, the impact on hospitalisations might be driven by the inadequacy of the care at home, rather than the delayed access to the nursing home. We test this by evaluating the correlation between fluctuations in nursing home congestion and the amount of care provided at home following a similar approach as described above: within a sample of individuals using the variable package of the Long-term Care Act, we calculate the average home care expenditures per recipient. These expenditures reflect the amount of home care provided conditional on receiving care at home. There is no evidence that formal home care supply per user is lower in periods of long delays for nursing home admissions: we correlate this with the instrument and find no meaningful correlation (Appendix Table A7).

From the demand-side, threats to the instrument's validity arise when the composition of the group of individuals who receive eligibility differs in times of congestion than when access is more readily available. This could happen if unhealthier people strategically apply for eligibility in advance to attain a more favourable place on the waiting list when congestion is particularly acute.

The potential concerns about a correlation between the health of applicants and congestion is largely addressed by the eligibility process. The assessment procedure that determines the eligibility for nursing home care is legally based solely on the care needs of applicants (Bakx et al., 2021), and not on the availability of nursing home beds. Given that the assessment is carried out by an independent organisation, there are also no incentives to adapt the eligibility decisions based on the availability of resources.

While the eligibility assessment provides a minimum threshold in terms of care needs, there could be heterogeneity in care needs above this threshold correlated with congestion. We address this potential concern in two ways. First, we check whether the distribution of observable characteristics is equal across different levels of congestion. This check is informative because the data contain a rich set of relevant observed characteristics, of which some, like the availability of potential informal care givers, are not included in the assessment procedure. By examining

[21]Studying the extensive margin will be less suited for the exercise as virtually all individuals receive formal care at home during their delay.

whether there exists imbalance in observed characteristics of individuals across levels of the proposed instrument, we can infer whether imbalances across unobserved characteristics are also likely. Table A8 in the Appendix demonstrates that the observed (and by inference, unobserved) characteristics of individuals who receive eligibility in times of high congestion are not different from those of individuals who receive it at times of low congestion.

Second, we can informally test whether there are differences in the characteristics of the people applying for eligibility when there is a little or a lot of congestion. We can do this by looking at rejection rates for eligibility. A part of the individuals' underlying health at the moment of applying for eligibility might not be measured by the characteristics that we observe, but might be observed by the eligibility assessor. Hence, if individuals who apply for eligibility in times of congestion are in better (worse) unobserved health, we would expect the eligibility assessment result to be negative (positive) more often during these periods. Using data on all individual eligibility decisions made during our observation period, we find no correlation ($\rho = 0.0029$) between congestion and the share of negative eligibility assessment results over time (results are reported in Appendix Table A7). This suggests that the individuals who apply for eligibility when there is high congestion are not systematically different in terms of their care needs (as observed by the independent care needs assessor) compared to those who apply when there is low congestion (independence).

Monotonicity
We also assume monotonicity in the effect of the instrument. In our setting, this implies that increasing levels of congestion cannot increase delays for some individuals whilst decrease delays for others. As such, monotonicity rules out defiers. While this condition cannot be tested at the individual level, we can verify whether delays monotonically increase with congestion for different subgroups of our population. Appendix Figure A5 demonstrates that the relationship between congestion and individual delays is strictly positive for different levels of congestion and across subgroups of care profiles. Such findings at the group level indicate the plausibility of a weaker monotonicity assumption, under which the estimated effect can be interpreted as a (proper) weighted average of individual treatment effects (Frandsen et al., 2023), even if monotonicity does not hold for every region or time period.

5 Results

5.1 Urgent hospitalisation probability

Full sample
Table 3 presents the 2SLS estimates, $\hat{\beta}$, from Equation (1). The results using the full sample, presented in column (1), suggest that a increasing delay to a nursing home admission by one day increases the probability of an urgent hospitalisation due to a health shock by 0.086 percentage points. The estimated coefficient

is statistically significant at the 1 percent level and economically meaningful: individuals who delay by one additional month (or one-third of the standard deviation in predicted delays) are 2.6 percentage points more likely to have an urgent hospitalisation within the year following eligibility. This effect of a 1-month is equivalent to an 15% increase relative to the (uncorrected) one-year urgent hospitalisation rate and implies longer delays in accessing nursing home care increase urgent hospitalisations at the extensive margin.

Table 3: The effect of delayed nursing home admissions on urgent hospital use

	Full sample	By care profile		
		Dementia care needs	Moderate somatic care needs	High somatic care needs
	(1)	(2)	(3)	(4)
$\widehat{Delay}$ (in days)	0.000858***	0.000900*	0.000553	0.0121
	(0.000240)	(0.000515)	(0.000665)	(0.0114)
Care profile fixed effects	Yes	No	No	No
Observations	76,453	37,803	25,666	12,984
Mean dept. var	0.1712	0.1262	0.2321	0.1821

Table reports the second stage results. First stage results are reported in Table 2.
All models include all covariates and year, region and care profile fixed effects.
Robust standard errors between brackets. *** Statistically significantly different from zero at 1 percent; ** at 5 percent; * at 10 percent.

By care profile
We differentiate between groups based on care profile at eligibility to identify groups that are particularly vulnerable to the consequences of delayed access to nursing home care. The results in columns (2) to (4) in Table 3 show that the estimated impact for the full sample (column (1)) is largely driven by the 49% of the study population with dementia care needs. For these individuals, a one-month increase in delays increases the probability of at least one urgent hospitalisation within the year following eligibility by 2.7 percentage points. This represents a 22% increase relative to the mean one-year hospitalisation risk for this group. While the estimated effects for the somatic care profiles are economically meaningful, they are imprecisely estimated and not statistically significant at the 10% level. For the high somatic care needs group, this is likely because of a weak first stage (reported in Table 2). Accordingly, we interpret these results with extreme caution. The difference between the subgroups is plausible for two reasons. First, assessing the urgency of someone's nursing home admission (either by an individual, a relative or a professional) may be more ambiguous for people with dementia because the disease profile and appropriate treatment may be less obvious than for physical impairments. Second, people with moderate somatic care needs mainly require particular medical care (e.g. administering medication) and assistance with daily activities such as dressing and feeding, while people with dementia may also require help with cognitive tasks. Exten-

sive home care, consisting of regular visits to the care recipient, can more easily provide assistance for regular medical care and daily activities, but may fail to do so for other tasks that are important for preventing adverse health events that require hospitalisations.

Comparison to OLS results
We report the results from a regression without accounting for selection bias from unobservables and reverse causality in Panel A of Appendix Table A6. The OLS estimate for the full sample (statistically significantly different from zero at 1%) is one third of the size of the IV-estimate reported in Table 3. This is in line with our expectations that the OLS estimate is biased towards zero driven by: i) individuals with better underlying health likely having longer delays and a lower risk to be hospitalised due to a health shock; and ii) hospitalisations while waiting for a nursing home bed causing shorter delays.

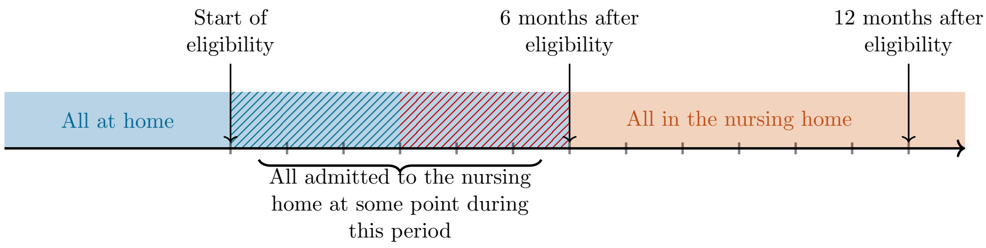
Characterising compliers
We estimate a Local Average Treatment Effect (LATE) which is based on the group affected by the instrument (compliers).[22] To understand the characteristics of this group, we estimate the first stage of 2SLS for a number of subgroups (Appendix Figure A6). The coefficients are somewhat larger among individuals who are older, had higher expenditures on hospital care in the calendar year prior to receiving the eligibility status, and for those with a higher predicted probability of a hospitalisation in the year after eligibility based on observed characteristics.[23] The first-stage coefficient is smaller for individuals who were hospitalised in the 30 days prior to eligibility.

Taken together, this means that individuals with higher health care consumption, with the exception of those who were recently hospitalised, are more strongly affected by congestion and more likely to be in the group of compliers. This is in line with our expectations as individuals in better health may always prefer to delay, and receive long-term care in their own home, irrespective of congestion in the market, while individuals in poorer health and with higher care needs will delay only when required to do so.

[22]Compliers are those who delay more during periods of more congestion, for example, because they wait for an available bed at their preferred provider. IV estimation is not identified off i) those who do not delay even when there is congestion (i.e. always-takers), for example, because their admission is very urgent; and ii) those who delay even when there is no congestion (i.e. never-takers), for example, because they would always prefer to postpone their admission to maintain independent living.

[23]Sex, age, medication consumption, healthcare expenditures, prior hospital visit (yes/no), wealth, being a house owner, living alone, neighbourhood characteristics, Charlson comorbidities and receiving the eligibility status during fly season.

Figure 4: Timeline - differentiating between direct and indirect effect



Notes: In this sub sample, everyone is admitted to a nursing home between the start of eligibility and 6 months after. Hospitalisations occurring within 0-6 months after **eligibility** capture both the direct and the indirect effect, while those occurring within 6-12 months only capture the indirect effects of a shorter exposure to nursing home care.

5.2 Mechanisms: direct versus indirect effect of shorter exposure to nursing home care

Delaying a nursing home admission may affect hospitalisations via two mechanisms. First, delaying a nursing home admission increases the time spent at home in frail health. We hypothesise that this increases the risk of an urgent hospitalisation *directly* if the living environment at home and the level of supervision are less suited for individuals with disabilities than in a nursing homes, which can lead to falls and other accidents and health shocks. Second, an individual's chronic physical and cognitive conditions might deteriorate more rapidly at home during the delay because the care is less adequate, e.g. because of inappropriate or inadequately monitored polypharmacy, poor adherence to treatment, or less physical and cognitive stimulation. In this second case, delayed admissions may not only lead to health shock during the delay but also *indirectly* increase the hospitalisation risk after being admitted to a nursing home. Our main analysis measures the composite of these two effects. To separate these effects, we run separate analyses for a period in which at least part of the sample remains at home waiting and for a period in which the entire sample is living in a nursing home. If we find effects in the first period but not in the second, this suggests a direct effect of staying longer at home, while effects that persist in the period in which everyone is in a nursing home are interpreted as evidence in favour of an indirect effect.

We construct a new sample in which all individuals are admitted to a nursing home within six months following eligibility and everyone survives at least one year after eligibility. We then run the same analysis as previously for two different outcomes: i) urgent hospitalisations occurring within zero to six months following eligibility (when individuals may still be waiting at home); and ii) urgent hospitalisations occurring within six to twelve months following eligibility (when everyone is in a nursing home, see Figure 4). We repeat this process using cutoffs at three and one and a half months separately.

Table 4: 2SLS results - Direct versus indirect effect of delays

	Outcome: urgent hospitalisation		
	Full period	Period both at home and in a nursing home (both direct and indirect)	Period in a nursing home only (indirect only)
	(1)	(2)	(3)
Panel I: sample of those admitted in 6 months following eligibility			
	0-12 months	0-6 months	6-12 months
$\widehat{Delay}$ (in days)	0.00166***	0.00158***	0.000347
	(0.000524)	(0.000444)	(0.000368)
First stage F-stat (instrument)	246.4	246.4	246.4
Observations	67,109	67,109	67,109
Mean dept. var	0.164	0.109	0.0709
Panel II: sample of those admitted in 3 months following eligibility			
	0-6 months	0-3 months	3-6 months
$\widehat{Delay}$ (in days)	0.00408***	0.00328***	0.000714
	(0.00150)	(0.00126)	(0.000945)
First stage F-stat (instrument)	77.10	77.10	77.10
Observations	57,540	57,540	57,540
Mean dept. var	0.105	0.0690	0.0416
Panel III: sample of those admitted in 1.5 months following eligibility			
	0-3 months	0-1.5 months	1.5-3 months
$\widehat{Delay}$ (in days)	0.00542*	0.00455*	0.000158
	(0.00304)	(0.00246)	(0.00198)
First stage F-stat (instrument)	31.90	31.90	31.90
Observations	52,129	52,129	52,129
Mean dept. var	0.0781	0.0505	0.0315

All models include all covariates and year, region and care profile fixed effects. Standard errors between brackets. *** Statistically significantly different from zero at 1 percent; ** at 5 percent; * at 10 percent.

Table 4 shows that the effect of delays on urgent hospitalisations is not driven by hospitalisations during the period spent in the nursing home. Within the sub-sample of individuals delaying by less than 6 months, delaying a nursing home admission by one additional month increases the probability of an urgent hospitalisation within the year following eligibility by 5 percentage points (column 1).[24] This is almost entirely explained by hospitalisation occurring in the first six months after eligibility (column 2). In the period following the initial six months, when everyone has been admitted to a nursing home, the effect is only 1 percentage point and is not statistically different from zero at the 10 percent level (column 3). The difference in effects between the two periods is consistent across various cut-off points (6, 3 or 1.5 months). Furthermore, the finding is

[24]This result also shows that the direction of our estimate from the main specification in Table 3 is robust to choosing a different time frame.

not driven by hospitalisations during the first period affecting further hospitalisations in the second period since estimation on a sub-sample of individuals without a hospitalisation in the first period generates similar results.[25]

The results suggest that once individuals are admitted to a nursing home, they face a hospitalisation risk that is independent of how long they delayed their admission. This suggests that the increased risk of being urgently hospitalised due to a delay is not driven by individuals with long delays being in poorer health upon entering the nursing home. Alternatively, the impact is likely driven by adverse health events, which are more likely to occur at home than in a nursing home, with delays prolonging the period of care received in a less protective environment at home.

5.3 Heterogeneity: living alone or with others

If the impact of delays on urgent hospitalisations is driven by a shorter exposure to the protective environment of a nursing home, could the effect be mitigated by living together with others, who could act as an informal caregiver? We evaluate this by estimating the effect of delays for nursing home care for two subgroups separately: i) individuals living alone when receiving their eligibility status; and ii) individuals living together with someone else, such as a spouse or child(ren). We show these effects only for the full study population and for the dementia care group only as these samples produce first-stage F-statistics that are sufficiently large to rule out problems due to weak instruments.[26]

The first stage 2SLS results, reported in Panels I.B and II.B of Table 5, suggest that delays of individuals who are living alone are similarly affected by within-regional variation in congestion as those who live with someone else. This suggests that the individual's household situation is of little influence in the decision to delay a nursing home admission after the decision to request eligibility is made.

Hospitalisation rates are only affected by delays for individuals who live alone at the moment of receiving eligibility status (Panel I.A in Table 5). Delaying a nursing home admission by one additional month increases the probability of an urgent hospitalisation by 3 percentage points among those living alone. The corresponding effect for individuals living alone with dementia care needs is also positive and statistically different from zero at the 5% level. In contrast, individuals living with a partner or child(ren) appear to be better protected against the negative consequences of longer delays: none of the estimated effects are statistically different from zero.

This suggests that living with someone else may mitigate the impact of delays

[25]The estimated coefficient using the same model and sub sample – conditioned on not having a hospitalisation in first period – is small (i.e. 0.00024 at 6-12 months, 0.00148 at 3-6 months and 0.00148 at 1.5-3 months) and non-significant at 5 percent (p-values between 0.15-0.53).

[26]Results for all care profiles are available upon request.

Table 5: The effect of delayed nursing home admissions on urgent hospital use separated by individuals living alone or with others

	Full sample	Dementia care needs
Panel I: Living alone		
Panel I.A: Second stage result (outcome = urgent hospital use)		
$\widehat{Delay}$ (in days)	0.00101***	0.00175**
	(0.000306)	(0.000837)
Panel I.B: First stage result (endogenous var = delay in admission)		
Instrument: congestion	0.505***	0.326***
	(0.0335)	(0.0649)
F-statistic	226.8	25.25
Care profile fixed effects	Yes	No
Observations	47,934	20,974
Mean dept. var	0.178	0.130
Panel II: Living with a partner, child(ren) or other		
Panel II.A: Second stage result (outcome = urgent hospital use)		
$\widehat{Delay}$ (in days)	0.000522	0.0000865
	(0.000394)	(0.000679)
Panel II.B: First stage result (endogenous var = delay in admission)		
Instrument: congestion	0.510***	0.403***
	(0.0482)	(0.0780)
F-statistic	111.8	26.65
Care profile fixed effects	Yes	No
Observations	28519	16829
Mean dept. var	0.160	0.121

Panel I shows the 2SLS results for a subgroup of individuals living alone at the moment of receiving eligibility and Panel II for those living with a partner, child or other. Panels I.A and II.A report the second stage results and Panels I.B and II.B the first stage results for each of the subgroups.
All models include all covariates and year, region and care profile fixed effects. The reported F-statistic denotes the effective F statistic on the excluded instrument (see also Footnote 18).
Robust standard errors between brackets. *** Statistically significantly different from zero at 1 percent; ** at 5 percent; * at 10 percent.

on urgent hospitalisations due to health shocks. While virtually all individuals receive formal care at home during their delay, having a partner or child(ren) at home while waiting for an admission might make up for the lack of round-the-clock supervision or care, which may be crucial for preventing health shocks and hence urgent hospitalisations.

5.4 Other hospital-related outcomes and mortality

5.4.1 Non-urgent hospitalisations, falls and days in hospital

In addition to examining the impact of delays on the probability of an urgent hospitalisation, we evaluate its impact on other hospitalisation-related outcomes. Results are presented in Table 6. The first two columns show the effect of delays on all hospitalisations (column 1) and non-urgent hospitalisations (column 2). The effect of delays is the same for all hospitalisations as it is for urgent hospitalisations. The effect on non-urgent hospitalisations is small and not significantly different from zero. Taken together we can infer that there is no relationship between delays and the use of elective hospital care.

Table 6: 2SLS results - Other health related outcomes

	Other hospital related outcomes				
	All hospitalisations	Non-urgent hospitalisations	Hospitalisation due to a fall (urgent)	# days in hospital (urgent)	# days in hospital (urgent) if urgent hospitalisation
	(1)	(2)	(3)	(4)	(5)
$\widehat{Delay}$ (in days)	0.000958***	0.000190	0.000376***	0.0156***	0.0426***
	(0.000259)	(0.000152)	(0.000139)	(0.00346)	(0.0137)
Observations	76,453	76,453	76,453	76,453	13,091
Mean dept. var	0.2153	0.0594	0.0517	1.4821	8.6557

	Mortality			
	Including 2018		Excluding 2018	
	12-18 months after eligibility	12-24 months after eligibility	12-18 months after eligibility	12-24 months after eligibility
	(6)	(7)	(8)	(9)
$\widehat{Delay}$ (in days)	0.000456**	0.000570**	-0.000259	0.000127
	(0.000218)	(0.000275)	(0.000361)	(0.000454)
Observations	76,453	76,453	52,226	52,226
Mean dept. var	0.145	0.280	0.145	0.275

2SLS results for other outcomes of interest. All other hospital related outcomes are measured in the 365 days following eligibility (columns 1-5); Mortality is measured 12-18 months and 12-24 months after eligibility, when everyone has been admitted to the nursing home; Columns 8-9 exclude the year 2018 to omit mortality during the Covid-19 pandemic; All models include all covariates and care profile, year and region fixed effects in both the first and second stage.

Detailed definitions of outcome variables are reported in Appendix Table A1.

Robust standard errors between brackets. *** Statistically significantly different from zero at 1 percent; ** at 5 percent; * at 10 percent.

We also consider the most common diagnosis for urgent hospitalisations, namely being hospitalised following a fall (including secondary diagnoses). The risk of falling is strongly related to the appropriateness of the living facilities (e.g. the presence of stairs, obstacles, unequal floors) and the availability of constant supervision (Serrano-Alarcón et al., 2022). Column (3) of Table 6 shows that delaying nursing home admission by an additional month increases the risk of a hospitalisation due to a fall by 1.1 percentage points. This is more than 20% of the average hospitalisation rate for falls in the entire sample, and falls explain over 30% of the effect of all urgent hospitalisations.

Columns (4) and (5) show the impact of delays on the number of days spent in hospital (for urgent visits) within the year following eligibility. Results in column (4) capture both the impact on the extensive margin, and the intensive margin. The results in column (5) are for the study population having at least one urgent hospitalisation, and measures the impact on only the intensive margin: do people who were urgently hospitalised remain longer in hospital if they delayed their nursing home admission? The results indicate that individuals who delay their admission to the nursing home spend more days in hospital. Conditional on being urgently hospitalised, an additional month delay for an admission to a nursing home leads to 1.3 further days in hospital. A plausible explanation for this effect is bed-blocking: individuals remain longer in a hospital because they cannot be discharged to a nursing home (Gaughan et al., 2015; Moura, 2022).

5.4.2 Mortality after admission

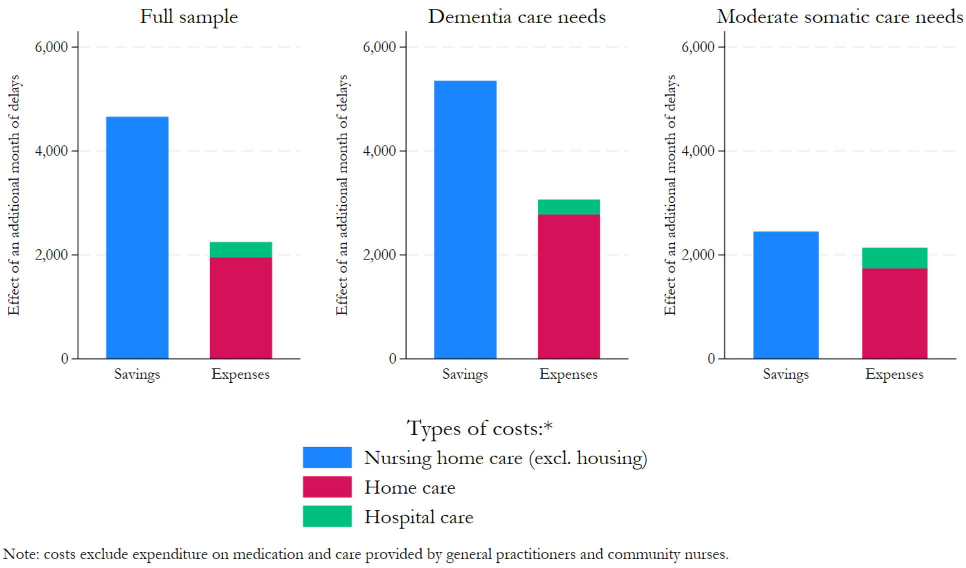
To further quantify health effects, we also estimate the impact of delays on mortality. Our study population is restricted to individuals surviving the first 12 months following eligibility and for whom delays to entering a nursing is a maximum of 12 months (see Section 3.2). Accordingly, we focus on deaths that occur once everyone is admitted to the nursing home (after 12 months post eligibility). Table 6 reports the estimated effects of delays on mortality within 12-18 months and separately for 12-24 months following eligibility. While statistically significant at the 5% level, the estimated impacts of a delayed admission on both mortality outcomes are modest relative to the mortality rate in this sample: an additional one-month delay in the admission increases the probability to die in 12-24 months after eligibility by 6 percent relative to the baseline probability. This implies that longer delays prior to being admitted to a nursing home slightly increase the probability of death long after the admission. For those receiving their eligibility in the year 2018, this period includes the Covid-19 pandemic, which also had a big impact on nursing home mortality. When excluding the individuals who received their eligibility status in 2018, the effect is much smaller and not statistically different from zero.

5.5 Costs spillovers

To better understand the broader welfare consequences of delayed access to nursing home care, we analyse the costs of a one month delay within each of the care profiles. Using the same approach as for the main analysis, we estimate expenditures for nursing home care, formal home care and hospital care use in the year following eligibility. Point estimates are reported in Appendix Table A9 and Figure 5. When individuals delay their admission to the nursing home, this naturally decreases the expenditure related to nursing home care, but at the same time increases the expenditure for formal care at home received during the delay. This is illustrated by Figure 5. The blue bar shows that delaying a nursing home admission by one additional month saves €4,656 on nursing home care (excl. costs for housing) per individual in the year following the eligibility date.

At the same time, more than 40 percent of this amount is offset by additional expenditures on formal care at home: the red bar shows that an extra month of delay increases expenditures for receiving care at home during the delay by €1,942 per year, driven by individuals substituting nursing home care by formal care at home during the delay. Additionally, longer delays result in increased hospitalisations. We estimate an additional month of delay to increase hospital care expenditures by €295 in the year following eligibility.

Figure 5: Savings and expenses related to an additional month of delay



Notes: This figure shows savings and expenses due to an additional month of delay in being admitted to a nursing home. The effects are estimated using Equation (1) (see also Appendix Table A9 for point estimates). Note that these costs exclude expenditure on medication and care provided by general practitioners.

When comparing across care profiles, we find a larger gap between savings and expenditures among individuals with dementia care needs. While savings from longer delays are almost entirely offset by additional expenses on home and hospital care for individuals with moderate somatic care needs, only 60% of the savings are offset for individuals with dementia care needs.

5.6 Robustness checks

We test the robustness of our main findings to three types of changes. First, we examine how sensitive our results are to the exclusion of individuals who were not living in a nursing home anymore one year after eligibility, either because they moved out or died. These individuals were excluded in the main analysis since we focus on permanent nursing home moves only and delays are directly affected by deaths. However, excluding individuals who died may imply that our estimate would be a lower-bound estimate of the true effect because of a selective 'survivor effect' - survivors are likely to be in better health, more likely to delay, and less likely to be hospitalised. The results using a sample including individuals who died within the year after eligibility (see column (1) of Appendix Table A10) supports this prediction as the estimate is slightly larger than (but not statistically different from) the main result.

Second, to further analyse whether our results are driven by sudden shocks that affect both nursing home congestion and hospitalisations (violating the exclusion restriction), we include month-by-year fixed effects in our two-stage least squares regression. Our results are robust to including these (column (2) of Appendix Table A10).

Finally, we run the analyses using four different specifications of the instrumental variable, which in our main specification is the average delay of other individuals with the same care profile, living in the same care office region, receiving the eligibility status in the 46 days before and after the individual's own eligibility. We test the following adaptations: i) use smaller regions (i.e. municipalities); ii) use a more narrow time window of 30 days before and after the individual's own eligibility; iii) shift the time window to 92 days *before* the individual's own eligibility; and iv) calculate a weighted average of delays with weights based on distances from the individual's place of residence to the J_{irp} other individuals' residences. Overall the result appears robust to these changes (column (3) - (6) of Appendix Table A10). The same holds for the analyses by care profile (results are available upon request).

6 Discussion

6.1 The spillover effects of delayed nursing home admissions on hospitalisations and costs

Delaying a nursing home admission by one month increases the probability of an urgent hospitalisation due to a negative health event such as a hip fracture, heart attack or stroke by 2.6 percentage points. Our results indicate that the lack of a protective environment at home during the delay is the most likely driver of this effect.[27] These results are in line with those of Bakx et al. (2020), Moura (2022) and Serrano-Alarcón et al. (2022) who find that access to nursing home care

[27]Another potential explanation would be that, unlike in the home situation, nursing homes engage in advanced care planning and this would include adhering to the wish of some clients not to be admitted to a hospital anymore in case of a severe health shock. While advanced care planning is common in nursing homes, most of the main health shocks leading to urgent hospitalisations (reported in Appendix Table A4) would lead to a much poorer survival prognosis if untreated. Yet, we do not find a strong effect on mortality in the 12-24 months after eligibility and therefore expect the impact of advanced care planning on the probability of a hospitalisation conditional on a health shock to be limited.

decreases the probability of an (avoidable) hospitalisation and shorter hospital stays. Our findings reveal that this relationship also holds when variation in access comes from waiting lists as a rationing measure, which affect how long an individual has access rather than whether the individual has access at all.

At the population level, the results suggest that a one-month reduction in the average delay for all 56,000 Dutch new nursing home residents per year (NZa, 2023) would prevent approximately 1,500 individuals to be hospitalised for a health shock, and a total of 27,000 hospital days. There are different underlying causes responsible for the effect on hospitalisations which makes it challenging to summarise the overall effect on health. Using a rough estimate of 0.4 Quality Adjusted Life Years (QALYs) lost for health shocks (calculations can be found in Appendix A.3), shortening the average delay in admissions to nursing homes by one month would lead to an annual gain of 600 QALYs in the Netherlands. It is important to note that, due to the construction of our estimation sample, which conditions on survival until one year after eligibility, our estimates only include health shocks that do not lead to immediate death.[28] Also taking into account that we do not observe any health effects that do not lead to a hospital admission, our estimate of the health effects of delays is likely a lower bound.

The cost savings in nursing home care resulting from longer delays are partly offset by increased use of formal home care and hospital care. A delay of a nursing home admission by one months means, on average, an individual consumes €4,656 worth less nursing home care, but half of this is offset by use of home care and hospital care. The total spillover effects are likely to be even larger, as other care types like primary care and medication are not included. Although data on these services cannot be directly included in our estimation, a tentative calculation (outlined in Appendix Table A11) indicates that these other spillover costs would amount to around €700 per month of delay. On average, the average effect of a one-month delay in nursing home admission would then decrease from €4,656 when only considering long-term care to €1734 when taking spillover effects to the rest of the health care sector into account (calculations can be found in Appendix A.3).

For individuals with moderate somatic care needs, the cost savings are almost entirely offset by the additional expenses for home care and hospital care. Nursing home care is more expensive for individuals with dementia and approximately 60% of savings due to delayed access are offset by additional spending on care at home and in hospital. These findings suggest that individuals with moderate needs receive similar levels of formal care regardless of the setting. The finding that the cost difference between receiving care at home and in a nursing home is smallest among those with relatively low care needs, is in line with findings by Bakx et al. (2020) on the effects of access to nursing home care in the Netherlands for a group of individuals with relatively low care needs.

[28]Effects on short-term mortality could potentially be estimated using a duration model in combination with an instrumental variable (Abbring and van den Berg, 2005), but would require strong assumptions on the model's functional form.

We have not considered spillover effects outside of the health care sector, the most important being effects on informal caregivers. Individuals who delay likely receive more informal care than those in a nursing home (Roquebert and Tenand, 2024). Incorporating the value of this informal care (Elayan et al., 2024) is expected to make the difference between savings and expenses of longer delays even smaller.[29]

6.2 Implications

The central policy debate in countries with ageing populations is how to organise and finance long-term care provided to meet increasing demand (Gruber et al., 2023). Our results contain three relevant insights for this debate.

First, stimulating ageing in place and rationing nursing home capacity can have adverse health consequences. Even in a setting like the Netherlands, with a very extensive provision of care and social assistance at home, it is currently not possible to fully prevent the negative health consequences from living in an environment not fully suited to the needs of individuals with physical and/or cognitive disabilities. This is especially true for individuals who live alone, stressing that successful ageing in place does not only require adequate housing and facilities (Diepstraten et al., 2020) but also sufficient supervision and support.

Second, the societal costs of living longer at home might outweigh the benefits. While delaying nursing home entry has substantial costs saving effects within the nursing home sector, these are mitigated by cost increases in the rest of the health care sector and likely the rest of society. If we take the tentative estimates of the health and costs effects above at face value, the cost-saving effect of delaying one nursing home admission by one month decreases from 448 thousand euro per QALY, when only considering nursing home care, to 163 thousand euro per QALY when spillovers to home care and medical care are included. Given that we likely do not capture all negative health effects and societal costs spillovers, the savings in societal costs are likely lower than the societal willingness to pay for health.[30] Naturally, our estimates pertain to one specific rationing mechanism (delays) and a specific context and do not imply that stimulating ageing in place is always sub-optimal. Our results do add to a growing body of evidence (Bakx et al., 2020; Kim and Lim, 2015; Serrano-Alarcón et al., 2022) showing that, across different rationing measures and contexts, the costs saving effects of ageing in place are smaller than policy makers often expect.

Third, our results indicate there may be scope to improve the allocation of nursing home beds. The results from our analysis of the characteristics of compliers show that individuals with higher care needs are the most likely to delay in periods with long waiting times, while, ideally, these individuals would have timely

[29] We cannot include these effects as no administrative data on informal care giving is available.

[30] For reimbursement decisions for the social health insurance the Netherlands uses a value of 80 thousand euros per QALY (Reckers-Droog et al., 2018).

access to a nursing home irrespective of the market situation. In addition, our results show that individuals who live alone benefit more from a nursing admission than those who live with a partner or child. Improving the allocation of care by prioritising these more vulnerable groups might generate positive welfare effects, both in terms of the value of health and reduced spillovers to other sectors. This can be done by improving the management of waiting lists, which is currently the responsibility of providers. It has been shown that more efficient allocation of beds could substantially reduce average waiting times in the Netherlands (Arntzen et al., 2022). Future research could focus on how and whether prioritisation from the waiting list can be organised more efficiently to ensure that the allocation of nursing home beds also generates improved outcomes. Alternatively, prioritising the most vulnerable groups prior to entering the waiting list could operate through considering changes in the needs-based criteria used in eligibility assessments, for instance by incorporating the applicant's living situation.

To conclude, we have shown that long-term care generates spillovers to other health care sectors, and these are important when designing policies on the provision of care to ageing populations.

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A Supplemental Appendix

A.1 Related literature

Our study contributes to the broader literature on spillover effects within and across sectors. For example, within the health sector, Pinchbeck (2019) provides evidence that improved access to primary care can reduce hospital emergency visits in England, therefore generating a positive spillover from primary to secondary health care. Within the long-term care sector, there is an extensive literature investigating the interface between informal care (e.g. provided by a spouse) and formal care (e.g. provided by a professional or care provider). For example, Kim and Lim (2015) find that subsidies to formal home care reduced informal care provision. In the opposite direction, there is evidence that informal care provision reduces the use of nursing homes and home care (Charles and Sevak, 2005; Van Houtven and Norton, 2004).

We focus on the interface and possible spillover effects between health and formal long-term care. The relationship can go in both directions: from post-acute health care to nursing homes (Einav et al., 2021; Eliason et al., 2018) or from nursing homes to health care (Bakx et al., 2020; Gaughan et al., 2015; Moura, 2022; Serrano-Alarcón et al., 2022).[31] For example, entry and reimbursement rules in the United States post-acute care sector are found to reduce nursing home care utilization. Einav et al. (2021) find that the entry of post-acute care hospitals can substitute care provided in nursing homes and create inefficiencies as care provided in hospitals is more costly. Similarly, Eliason et al. (2018) show that post-acute care providers respond to financial reimbursement incentives by discharging patients later to nursing home facilities.

We focus on spillovers from care provided by nursing homes to the health care sector. Related studies use regional variation to examine the effect of long-term care on health care utilisation. For example, Gaughan et al. (2015) and Moura (2022) exploit regional variations in the supply of nursing home care in the United Kingdom and Portugal and find that reduced supply leads to longer hospital stays. Other studies consider differences in public long-term care spending cuts or expansions across countries (Costa-i Font and Vilaplana-Prieto, 2022) and across smaller geographical units (Crawford et al., 2021; Forder, 2009). Their findings generally support the evidence of spillovers from long-term care to health care, documenting negative effects of long-term care spending on emergency department utilization and health care spending, though Crawford et al. (2021) find no effect on inpatient admissions or outpatient visits. There are a few other studies in which spillovers are identified using the introduction of long-term care insurance (Feng et al., 2020) or plausibly exogenous variation in eligibility for long-term care insurance benefits (Bakx et al., 2020; Kim and Lim, 2015; Serrano-Alarcón et al., 2022). The latter three studies compare individuals whose access to long-term care insurance benefit is determined by the leniency of a randomly assigned eligibility assessor (Bakx et al., 2020; Serrano-Alarcón et al., 2022) or

[31] See Spiers et al. (2019) for an overview including non-causal studies.

by an eligibility threshold (Kim and Lim, 2015). All studies find evidence of spillovers from long-term care to (urgent) health care use or spending. Yet, the impact of the duration of nursing home use remains unexplored. We contribute to this evidence by focusing on delayed admissions to nursing homes in the context of the Netherlands.

A.2 Details calculations expenditure on hospital care

Because we do not observe costs of hospital treatments in the year following eligibility directly, we calculate them based on the average healthcare expenditures on hospital care per diagnosis. We do this in five steps.

1. We construct a sample of all 65+ year-olds with an eligibility status in 2015-2018 with linked data on yearly hospital care expenditures and inpatient hospital visits, including length of stay and main diagnoses in ICD-10 blocks (World Health Organization, 2016).

2. For each person, we define the number of days spent in the hospital using the sum of the duration of all stays per calendar year. Additionally, we create dummies for each ICD-10 block, which represent whether the person received the particular ICD-10 block as a main diagnosis during at least one inpatient hospital stay.

3. We run a linear regression with hospital care expenditures as an outcome and the number of days spent in the hospital and all diagnosis dummies (i.e. ICD-10 blocks) on the right hand side. This gives us a daily hospital rate of €483, which is comparable to those reported in the Dutch Costing manual (Hakkaart-van Roijen et al., 2015), and the average hospital costs per diagnosis.[32]

4. We use these prices to calculate the costs for each hospital visit in our original sample. We do this by multiplying the daily rate by the length of stay and adding the estimated price of the main diagnosis from step 3. To reduce measurement errors, we only use the estimated prices of the 50 most common diagnosis, which cover 87 percent of all hospital visits in our original sample. For the remaining diagnoses, we use the average price of all other diagnoses.

5. Finally, for every individual, we sum the costs of all hospital visits in the year following eligibility. These hospital costs are used as an outcome in a 2SLS-regression, which estimates the impact of longer delays to nursing home admissions on hospital costs. The estimates are reported in Appendix Table A9 and Figure 5.

[32]These average costs for injuries to the hip and thigh, which is the most common diagnosis in our sample, are in line with those related to the procedure costs for hip fractures (Kanters et al., 2020).

A.3 Back of the envelope cost-benefit calculation

Health benefits

We aim to calculate the health benefits of a one month shorter delay for a nursing home admission. As we cannot measure health directly, we use findings from Kanters et al. (2020) who measure changes in Health Related Quality of Life (HRQoL) before and after a hip fracture (the most common health shock in our sample) among Dutch elders: on a scale of 0 (death) and 1 (full health), HRQoL is 0.16 lower in the first year after the fracture, and 0.11 lower thereafter.[33] Using the remaining life expectancy of 3.2 years, based on 85 year-old individuals living in institutions (such as nursing homes), we estimate a health shock to be associated with a reduction of roughly 0.402 ($= (-0.16 * 1) + (-0.11 * 2.2)$) Quality Adjusted Life Years (QALYs). Given that a one month shorter delay reduces the risk of a health shock by 2.6 percentage point, the health benefits of such a reduction in delays would be 0.0104 QALYs. This rough estimate is likely a lower bound of the actual health benefits as the estimate excludes any immediate mortality effects, which would reduce the remaining life years, and any health effects that do not involve a hospitalisation.

Costs

Rough estimates for the costs related to a reduction in the delay for a nursing home admission of one month for one individual are outlined in the table below.

Type of care	Costs (€)	Source
Nursing home care	4,656	Table A9
Home care	- 1,944	Table A9
Hospital care	- 295	Table A9
GP care	- 53	Table A11
Medication	- 260	Table A11
Community nursing	- 370	Table A11
Total	**1,734**	

Balancing costs and benefits

Using these tentative estimates, our results indicate a one-month reduction in the delay for a nursing home admission would on average generate 0.0104 QALYs and cost €1,700 per individual. Per year in full health (1 QALY), a reduction in delays costs approximately €163 thousand.

[33] These estimates are comparable to reductions in HRQoL from a stroke (Yeoh et al., 2019).

A.4 Appendix Tables

Table A1: Definitions of included variables and its source

Variable	Explanation	Data source(s)
Outcome variables		
Urgent hospitalisation	Binary indicator that equals one if individual had an urgent hospitalisation within one year after the start of eligibility. Hospitalisations are assessed as urgent if the hospitalisation should be realized within 24 hours after the judgment of the physician. Main diagnoses of (non-)urgent hospitalisations are reported in Table A4	Date of admission and discharge, diagnose and identifier for urgency from Dutch Hospital Data
Non-urgent hospitalisation	Binary indicator that equals one if individual had a non-urgent hospitalisation within one year after the start of eligibility.	Date of admission and discharge, diagnose and identifier for urgency from Dutch Hospital Data
Hospitalisation due to fall	Binary indicator that equals one if individual had an urgent hospitalisation within one year after the start of eligibility due to a fall, identified using ICD-10 codes W00-19 of sub diagnoses.	Date of admission and discharge, diagnose and identifier for urgency from Dutch Hospital Data
Number of days spent in the hospital	The sum of the length of stay of all urgent (inpatient) hospital visits within one year after the start of eligibility.	Date of admission and discharge, diagnose and identifier for urgency from Dutch Hospital Data
Nursing home care costs	Expenditure on nursing home care within the year after eligibility. Includes all costs covered by the public long-term care insurance (depending on the type of agreement - e.g. board, medication, medical care provided in the nursing home), but proportionally excludes €710 per month for housing (which is the maximum rent for social housing).	Start and end date of LTC use, type and costs of LTC use from Centraal Administratie Kantoor (CAK)
Home care costs	Expenditure on formal care at home within the year after eligibility. Includes all costs covered by public long-term care insurance, which can either be received in terms of a defined package (fixed price for a fixed amount of care) or variable package (price per delivered service - type of services reported in Figure A2).	Start and end date of LTC use, type and costs of LTC use from Centraal Administratie Kantoor (CAK)

Continued on next page

Table A1 – continued from previous page

Variable	Explanation	Data source(s)
Hospital care costs	(Estimated) costs of inpatient hospital stays within one year after eligibility covered by (mandatory) private health insurance. Calculated using the approach explained in Appendix A.2.	Date of admission and discharge and diagnoses per visit from Dutch Hospital Data; expenditures from Health Insurers, facilitated by Vektis
Variable of interest		
Delay of the nursing home admission	Number of days between the start of eligibility and the start of the first nursing home admission	Start date of eligibility from Centrum Indicatiestelling Zorg (CIZ); Start and end date of LTC use, type and intensity of LTC use from Centraal Administratie Kantoor (CAK)
Covariates		
Care profile	A care profile (in Dutch: Zorgzwaartepakket (ZZP)) is a proxy for the intensity of nursing home care that the recipient needs according to an independent care assessor from the Care Assessment Centre (CIZ). We define three categories: residents with moderate dementia care needs (ZZP 5); with moderate somatic care needs (ZZP 4); and with high care needs (ZZP 6-8)	Care profile at start eligibility from Centrum Indicatiestelling Zorg (CIZ); and Care intensity at start of nursing home admission from Centraal Administratie Kantoor (CAK)
Woman	Equals one if resident i is a woman	(Mandatory) municipal registries
Age	Age at eligibility. In the analyses transformed to five-year age groups.	Date of birth from (mandatory) municipal registries; and date of eligibility from Centrum Indicatiestelling Zorg (CIZ)
Healthcare expenditures	Yearly healthcare expenditures in €1000 (within the basic insurance package) either on GP care or on hospital care in the calendar year prior to eligibility	From Health Insurers, facilitated by Vektis
Hospitalisation in last 30 days	Binary indicator that equals one if individual was hospitalised in 30 days prior to eligibility	Date of admission and discharge from Dutch Hospital Data

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Table A1 – continued from previous page

Variable	Explanation	Data source(s)
Medicine consumption	(Prescribed) medicine consumed within the standard insurance package during the calendar year prior to the year of eligibility per ATC-code (3 digits). 18 relevant ATC-codes to include in analyses are selected using Lasso plugin estimators	4-digit ATC-code consumption (either Yes/No) from Zorginstituut Nederland
Charlson co-morbidities	17 dummies for co-morbidities that are generally used to calculate a Charlson comorbidity score (Sundararajan et al., 2004). Co-morbidities are identified using information on all hospitalisations in the year prior to eligibility	Date of admission and discharge and diagnose from Dutch Hospital Data
Household wealth	Total wealth of household, excluding the value of own property and mortgage, in the calendar year prior to eligibility, categorized: <5 thousand €; 5-20 thousand €; 20-50 thousand €; >50 thousand €	Tax office administration
Home ownership	Equals one if resident i owned a house at the end of the calendar year prior to eligibility	Tax office administration
Eligibility in flu season	Received eligibility status during the flu season, using flu starting week and period identified by Nivel (nd).	Start date of eligibility from Centrum Indicatiestelling Zorg (CIZ).
Living alone	Lived alone at the moment of receiving the eligibility status (=0); lived with another person (spouse, children or other) otherwise (=1)	(Mandatory) municipal registries
Neighbourhood: urbanity	Neighbourhood address density measured by the average number of addresses within a radius of one squared kilometer.	Neighbourhood statistics from Statistics Netherlands
Neighbourhood: share of population aged 65 and above	The population size aged 65 years and older divided by the total population in a neighbourhood.	Neighbourhood statistics from Statistics Netherlands

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Table A1 – continued from previous page

Variable	**Explanation**	**Data source(s)**
Neighbourhood: average distance from a general practitioner	Average distance (over the road) from the inhabitants' residences to the closest general practitioner in each neighbourhood.	Neighbourhood statistics from Statistics Netherlands

Table A2: Sample restrictions

	Sample size before exclusion	Number of individuals excluded	Percentage excluded (%)
Used in-cash scheme to purchase long-term care	145,866	2,683	1.8
Aged younger than 65 years	143,183	3,044	2.1
Delayed by more than one year	140,139	8,684	6.2
Received eligibility in hospital	131,455	12,861	9.8
Started making costs before eligibility	118,594	2,302	1.9
Died within one year after eligibility	116,292	33,441	28.8
Moved out of nursing home within one year after eligibility	82,851	4,856	5.9
Missing information on covariates	77,995	1,542	2.0
Final sample size	76,453		

Table A3: Care profile definitions

		Dementia or related condition	
		No	Yes
Care needs	Moderate	Moderate somatic care needs	Dementia care needs
	High	High somatic care needs	

Table A4: Most common diagnoses of urgent hospitalisations

ICD-10 block (World Health Organization, 2016)	Share of hospitalisations (%) Urgent: Full sample	Urgent, by care profile: Dementia care needs	Urgent, by care profile: Moderate somatic care needs	Urgent, by care profile: High somatic care needs	Non-urgent: Full sample
	(1)	(2)	(3)	(4)	(5)
20 most common diagnoses urgent hospitalisations (% of total)					
Injuries to the hip and thigh	27.6	11.7	8.9	17.0	0.7
Other forms of heart disease (incl. heart failure)	5.3	11.3	9.2	8.7	3.8
Influenza and pneumonia	6.8	8.1	8.5	7.7	0.4
Other diseases of the urinary system	5.8	5.6	10.6	6.6	2.6
Cerebrovascular diseases (incl. stroke)	4.4	6.0	3.9	5.0	1.0
Chronic lower respiratory diseases	2.1	4.9	4.9	3.9	0.8
Injuries to the head	3.7	3.9	2.2	3.5	
Symptoms and signs involving the circulatory and respiratory systems	2.1	3.9	2.9	3.1	0.7
General symptoms and signs	3.1	3.1	2.3	3.0	1.4
Episodic and paroxysmal disorders	1.9	2.6	3.1	2.4	0.8
Other diseases of intestines	2.0	1.8	3.2	2.1	2.2
Ischemic heart diseases	1.4	2.5	1.7	2.0	1.2
Complications of surgical and medical care, not elsewhere classified	1.3	1.6	3.1	1.8	3.0
Other bacterial diseases	1.4	1.4	2.5	1.6	
Disorders of gallbladder, biliary tract and pancreas	1.3	1.6	1.8	1.6	1.1
Injuries to the abdomen, lower back, lumbar spine, pelvis and external genitals	2.2	1.5	0.5	1.6	
Organic, including symptomatic, mental disorders (including dementia)	1.8	1.6	0.7	1.6	0.5
Other diseases of the digestive system	1.2	1.5	1.5	1.4	0.5
Metabolic disorders	1.0	1.4	1.4	1.3	0.3
Nutritional anemias	1.2	1.1	1.4	1.2	3.9
5 most common diagnoses non-urgent hospitalisations (% of total)					
Disorder of lens					8.8
Malignant neoplasms	0.6				8.3
Persons encountering health services for specific procedures and health care	0.1				7.3
Diseases of arteries, arterioles and capillaries	0.6				4.0
Nutritional anaemias	1.2				3.9
N (individuals)	13,091	4,771	5,956	2,364	5,022

Table reports share of twenty most common diagnoses of urgent hospitalisations for the full sample, and by care profile, and five most common diagnoses of non-urgent hospitalisations for the full sample. When individuals had multiple hospitalisations within the year after eligibility, only the first main diagnose is used to construct this table. Percentage of five most common non-urgent hospitalisations by care profile or if based on less than 10 observations not reported.

Table A5: Descriptive statistics delays in nursing home admissions per region and care profile

	All				Dementia care needs				Moderate somatic care needs				High somatic care needs			
Region	Mean	Median	Sd	N	Mean	Median	Sd	N	Mean	Median	Sd	N	Mean	Median	Sd	N
1	76.0	27.5	96.1	1182	82.5	37	96.8	580	97.3	53	105.9	363	28.0	7	53.9	239
2	64.8	21	91.2	2348	66.0	20.5	91.6	1112	85.5	42	99.9	809	22.8	5	49.7	427
3	52.1	9	80.6	1710	58.7	14	85.3	765	55.1	14	80.4	687	24.3	0	58.1	258
4	59.4	18	84.9	4760	62.2	19	88.1	2190	71.2	30	88.4	1738	27.3	1	56.3	832
6	37.3	7	67.3	2569	41.7	9	69.8	1363	39.2	7.5	70.2	768	20.2	1	48.7	438
7	57.6	18.5	81.2	648	66.6	29.5	86.4	324	60.0	22	80.8	199	30.4	4	59.8	125
8	31.6	6	59.6	3350	35.1	5	66.0	1541	34.3	11	56.8	1219	17.0	1	43.7	590
9	35.8	10	61.7	3110	37.6	10	63.3	1577	42.3	17	66.2	972	19.5	4	43.6	561
10	53.9	13	83.1	3537	58.2	14	85.8	1796	64.3	25	87.1	1187	17.3	0	47.8	554
11	60.4	18	86.9	2031	61.8	18	88.0	954	73.1	30	92.3	771	24.0	3	53.2	306
12	89.7	54	95.9	1766	95.4	53.5	104.5	634	97.7	69	92.7	914	39.7	20	62.0	218
13	76.0	29	96.0	948	88.5	48	99.1	447	83.5	44	96.1	323	30.9	4	71.9	178
14	43.8	10	75.2	913	47.5	13	75.1	414	50.7	14	83.0	339	19.6	2	49.1	160
16	62.6	18	88.3	2308	65.5	20	88.7	1253	81.0	38	97.3	624	27.5	1	58.7	431
17	88.9	49	97.9	2123	97.5	63	99.7	1101	94.9	58.5	99.3	688	48.7	16	77.1	334
18	65.0	22	88.7	2611	72.4	27	93.2	1257	68.7	30	89.3	1020	26.0	4	52.8	334
19	79.9	38	96.2	2790	88.0	48	99.5	1450	88.8	53	97.6	891	36.4	7	66.5	449
20	55.8	12	86.5	3055	60.4	12	90.5	1632	65.9	26	90.7	963	17.9	0	42.0	460
21	75.1	28	95.8	1650	84.3	39	98.7	853	94.7	49	104.0	479	21.0	8	39.3	318
22	51.9	12	82.0	3481	56.1	14	85.3	1788	62.1	22	87.5	1027	24.9	1	53.3	666
23	66.7	23	89.1	4904	74.4	36	91.0	2324	72.3	28	92.8	1797	31.2	7	62.6	783
24	51.4	10	78.7	1831	55.9	14	81.1	1162	65.1	23	85.7	355	19.6	0	47.4	314
25	65.4	27	85.5	3550	70.6	29	90.3	1434	76.8	43	87.1	1461	28.3	10	56.4	655
26	66.7	27	88.1	1274	79.5	40.5	93.3	676	63.5	28	83.4	367	34.2	6	69.0	231
27	50.3	11	81.0	2325	58.7	13	87.5	1255	50.3	14	78.5	637	25.9	1	56.7	433
28	64.4	19	89.0	2302	65.4	22	89.5	1215	82.1	44.5	95.0	718	26.4	0	58.4	369
29	68.5	21	93.4	1830	73.2	29	93.6	928	87.1	43	102.3	529	30.6	1	65.3	373
30	75.8	37	92.0	3223	80.3	44	92.6	1750	92.2	60	95.4	905	35.9	2	71.6	568
31	80.0	38	94.5	3624	93.0	52	100.5	1738	82.2	44	91.8	1287	37.6	14	65.6	599
32	58.0	16	87.3	2414	64.7	17	91.8	1134	64.8	23	90.1	799	30.9	5	63.5	481
33	80.2	27	101.1	2286	81.9	28.5	103.6	1156	96.2	59.5	102.0	830	29.3	0	67.3	300

Table reports the mean, median, standard deviation and count of delayed nursing home admissions per region and care profile.

Table A6: Ordinary least squares results

		By care profile		
	Full sample	Dementia care needs	Moderate somatic care needs	High somatic care needs
	(1)	(2)	(3)	(4)
Panel A: Outcome = urgent hospitalisation (OLS including covariates):				
Delay (in days)	0.000284***	0.000269***	0.000243***	0.000546***
	(0.0000168)	(0.0000208)	(0.0000302)	(0.0000678)
Panel B: Outcome = urgent hospitalisation (OLS including covariates):				
Congestion	0.000438***	0.000331*	0.000183	0.00106**
	(0.000122)	(0.000187)	(0.000220)	(0.000478)
Panel C: Outcome = urgent hospitalisation (OLS excluding covariates):				
Congestion	0.000426***	0.00035*	0.000058	0.00106**
	(0.000120)	(0.000180)	(0.000217)	(0.000475)
Care profile fixed effects	Yes	No	No	No
Observations	76,453	37,803	25,666	12,984
Mean dept. var	0.1712	0.1262	0.2321	0.1821

All regressions show the results of an ordinary least squares regression with a binary indicator for whether the individual had at least one urgent hospitalization in the year after eligibility as an outcome. Panel A includes the delay for a nursing home admission as an explanatory variable, and Panel B and C the instrumental variable (reduced form). All models include year and region fixed effects. Panel A and B include all covariates and Panel C excludes all covariates.

Robust standard errors between brackets. *** Statistically significantly different from zero at 1 percent; ** at 5 percent; * at 10 percent.

Table A7: Correlations between monthly delays, urgent hospitalisations of all 65+ year-olds, use of formal care at home and negative eligibility assessments

	Monthly variation in delays per region, excluding care profile, region and year fixed effects			
	Full sample	By care profile		
		Dementia care needs	Moderate somatic care needs	High somatic care needs
	(1)	(2)	(3)	(4)
Monthly variation per region, excluding care profile, region and year fixed effects:				
Urgent hospitalisations 65+ all year-olds (N)	-0.0893	-0.1212	-0.0720	-0.0836
Average expenditures on home care per recipient (€)	0.0393	0.0378	0.0297	0.0559
Negative eligibility assessment results (%)	0.0029	-0.0028	0.0167	-0.0103
Observations	4185	1395	1395	1395

Table reports correlation coefficients between the number of urgent hospitalisations among the full population of 65+ year-olds, the average per recipient costs on formal care at home from the Long-term Care Act among 65+ year-olds and the share of negative eligibility assessment results as decided upon by an independent assessor among 65+ year-olds.

Monthly variation in delays is calculated by taking the average delays per month-year and care profile, regressing it on region, year and care profile fixed effects, and using the residuals from this regression as variation. The other three variables represent the residuals of total hospitalisations, average expenditures or the share of negative eligibility results by region and month-year on region and year fixed effects.

The number of observations is equal to the number of regions (31 health care office regions) × number of periods (45 months-by-years) × care profiles (3 profiles).

Table A8: Relationship delays and congestion with covariates

	Delay		Congestion	
Woman	2.273***	(0.738)	-0.00331	(0.101)
Age 65-69	0.283	(1.761)	0.291	(0.240)
Age 70-74	2.828**	(1.278)	-0.164	(0.172)
Age 75-79	4.790***	(1.026)	-0.0464	(0.135)
Age 80-84	2.028**	(0.843)	-0.224**	(0.113)
Age 90-94	-3.977***	(0.934)	0.112	(0.131)
Age 95+	-9.507***	(1.506)	-0.401*	(0.228)
HC exp. on GP care (x1000)	-2.943**	(1.394)	-0.353*	(0.196)
HC exp. on hospital care (x1000)	-0.408***	(0.0348)	-0.0143**	(0.00582)
Hospitalization in last 30days	-18.65***	(1.261)	-0.00349	(0.209)
Wealth 5-20k	2.684***	(0.896)	0.0545	(0.124)
Wealth 20-50k	1.522	(0.932)	0.0503	(0.128)
Wealth >50k	0.0478	(0.928)	0.126	(0.127)
Home ownership	0.810	(0.698)	0.00266	(0.0939)
Neighbourhood urbanity	-0.00175***	(0.000332)	-0.0000351	(0.0000440)
Neighbourhood 65-year old	0.744	(6.000)	0.292	(0.813)
Neighbourhood distance GP	-1.425**	(0.564)	-0.0919	(0.0784)
Living alone	-1.553**	(0.684)	-0.198**	(0.0930)
ATC_A02	0.502	(0.705)	-0.0166	(0.0955)
ATC_A07	-1.170	(1.793)	0.196	(0.259)
ATC_A10	-0.000817	(0.787)	-0.163	(0.109)
ATC_B01	-0.613	(0.736)	-0.139	(0.100)
ATC_B02	6.258**	(2.917)	0.258	(0.380)
ATC_B03	-0.422	(0.899)	0.107	(0.125)
ATC_B05	0.703	(4.064)	-0.870	(0.603)
ATC_C01	-0.106	(0.907)	0.256**	(0.128)
ATC_C03	-1.703**	(0.677)	-0.0139	(0.0943)
ATC_C07	0.881	(0.684)	0.146	(0.0933)
ATC_C08	0.132	(0.752)	0.137	(0.105)
ATC_G04	0.135	(0.971)	-0.0519	(0.133)
ATC_H02	-0.0828	(0.940)	0.150	(0.134)
ATC_J01	0.569	(0.679)	-0.126	(0.0923)
ATC_L04	-1.590	(2.593)	-0.186	(0.383)
ATC_M04	-3.065*	(1.610)	-0.0731	(0.234)
ATC_N02	-2.287***	(0.771)	0.180*	(0.108)
ATC_N03	-2.032*	(1.228)	0.00621	(0.176)
ATC_N06	7.232***	(0.753)	-0.0793	(0.0977)
ATC_R03	-0.871	(0.900)	0.263**	(0.127)
ATC_V03	11.76**	(5.381)	0.155	(0.765)
Congestive heart failure	-16.25***	(1.811)	-0.352	(0.307)
Peripheral vascular disease	-13.80***	(3.406)	-0.231	(0.690)
Stroke	-27.54***	(0.865)	-0.226	(0.166)
Dementia	-29.14***	(6.006)	0.274	(0.916)
Pulmonary disease	-4.188*	(2.498)	-0.564	(0.380)
Connective tissue disorder	4.279	(10.65)	1.160	(1.719)
Peptic ulcer disease	-28.93***	(5.004)	-0.188	(0.942)
Liver disease	-1.066	(16.61)	0.951	(2.311)
Diabetes	-14.68***	(3.745)	1.046	(0.652)
Diabetes complications	6.691	(14.88)	0.609	(2.687)
Paraplegia	-28.80***	(5.427)	-1.819	(1.684)
Renal disease	-7.495	(6.909)	1.930*	(1.041)
Cancer	-10.67***	(2.641)	-0.0427	(0.394)
Metastic cancer	-14.56**	(6.690)	-1.690	(1.195)
Severe liver disease	-19.78	(13.84)	-2.177	(3.371)
Constant	81.15***	(3.514)	64.72***	(0.542)
F_test joint significance	36.14	[0.000]	1.342	[0.046]
F_test joint significance (excl. living alone)	36.61	[0.000]	1.297	[0.070]
Observations	76453		76453	

Robust standard errors between brackets. *** Statistically significantly different from zero at 1 percent; ** at 5 percent; * at 10 percent. P-values between parentheses.

Both regressions include a dummy for whether eligibility was received during an influenza period, and care profile, year and region fixed effects

Table A9: 2SLS results - Nursing home care, home care and hospital care costs by care profile

	Nursing home care			Home care		Hospital care
	Nursing home care costs	Nursing home care costs (excl. housing)	Home care costs	Home care costs - defined package	Home care costs - variable package	Inpatient hospital costs
	(1)	(2)	(3)	(4)	(5)	(6)
Full sample						
$\widehat{Delay}$ (in days)	-175.18***	-152.67***	63.96***	4.64**	59.32***	9.67***
	(4.52)	(4.41)	(3.02)	(2.49)	(2.65)	(2.80)
Observations	76,435	76,435	76,435	76,435	76,435	76,435
Mean dept. var	60,847	54,082	3,914	401	3,513	1,469
Dementia care needs						
$\widehat{Delay}$ (in days)	-198.42***	-175.38***	91.14***	11.74*	79.40***	9.35*
	(8.80)	(8.56)	(7.82)	(6.53)	(7.11)	(4.87)
Observations	37,799	37,799	37,799	37,799	37,799	37,799
Mean dept. var	65,633	58,988	4,770	420	4,350	951
Moderate somatic care needs						
$\widehat{Delay}$ (in days)	-103.64***	-80.21***	57.19***	-0.30	57.50***	12.92
	14.21	13.99	7.63	6.23	6.34	8.42
Observations	25,657	25,657	25,657	25,657	25,657	25,657
Mean dept. var	47,144	40,603	3,608	425	3,182	2,041
High somatic care needs						
$\widehat{Delay}$ (in days)	133.16	159.05	89.96*	25.48	64.48	81.51
	293.24	295.43	48.82	47.30	46.72	86.04
Observations	12,979	12,979	12,979	12,979	12,979	12,979
Mean dept. var	74,000	66,439	2,027	296	1,731	1,843

2SLS results for other outcomes of interest. Outcomes are measured in the 365 days following eligibility; All models include all covariates and care profile, year and region fixed effects in both the first and second stage.

Robust standard errors between brackets. *** Statistically significantly different from zero at 1 percent; ** at 5 percent; * at 10 percent.

Table A10: 2SLS results - Robustness tests

	Including incomplete observations (e.g. deaths)	Add month-by-year fixed effects	Instrument definitions			
			Smaller regions (municipalities)	Narrower time window (30 days before and after eligibility)	Change time window to 92 days before eligibility	Weighted average based on inverse distance to other eligible individuals
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Second stage result (outcome = urgent hospital use)						
$\widehat{Delay}$ (in days)	0.00099***	0.00086***	0.000534**	0.000849***	0.000895***	0.000566***
	(0.00022)	(0.00027)	(0.000207)	(0.000258)	(0.000237)	(0.000207)
Panel B: First stage result (endogenous var = delay in nursing home admission)						
Instrument: congestion	0.488***	0.468***	0.205***	0.420***	0.517***	0.256***
	(0.0210)	(0.0286)	(0.0104)	(0.0245)	(0.0275)	(0.0130)
F-statistic	540	269	387.0	293.2	352.4	386.1
Observations	113,774	76,453	75200	76453	76335	76447

Table reports first and second stage results of the main analyses with small corrections to analyse the robustness of the main results. Column (1) includes all previously deleted individuals because they either died or moved out of the nursing home within one year after eligibility. Column (2) includes month-by-year fixed effects in both the first and second stage regression. Columns (3) to (6) tests how robust the main result is to changes in the definition of the instrumental variable, namely using fluctuations in delays within smaller regions (i.e. municipalities), using a narrower time window of 30 instead of 46 days before and after the individual's own eligibility, replacing the time window to include other individuals who received eligibility just before the individual's own and calculating a weighted average of delays by distances from the individual's place of residents to the other individuals' residents who have the same care profile and are eligible in the same region and period.

All first and second stage regressions include all covariates and care office region, year and care profile fixed effects.

Sample sizes slightly deviate between the instrument specifications due to the omission of very small municipalities in column (3), dropping observations who received eligibility on April 1 or 2 to construct an instrument using data from January 1 2015 of all eligible individuals 92 days before in column (5) or with missing detailed address data.

Robust standard errors between brackets. *** Statistically significantly different from zero at 1 percent; ** at 5 percent; * at 10 percent.

Table A11: Comparison of expenditure on medication and care provided by general practitioners and community nurses between those delaying 0-1 month and those delaying 1-2 months among those receiving eligibility in January.

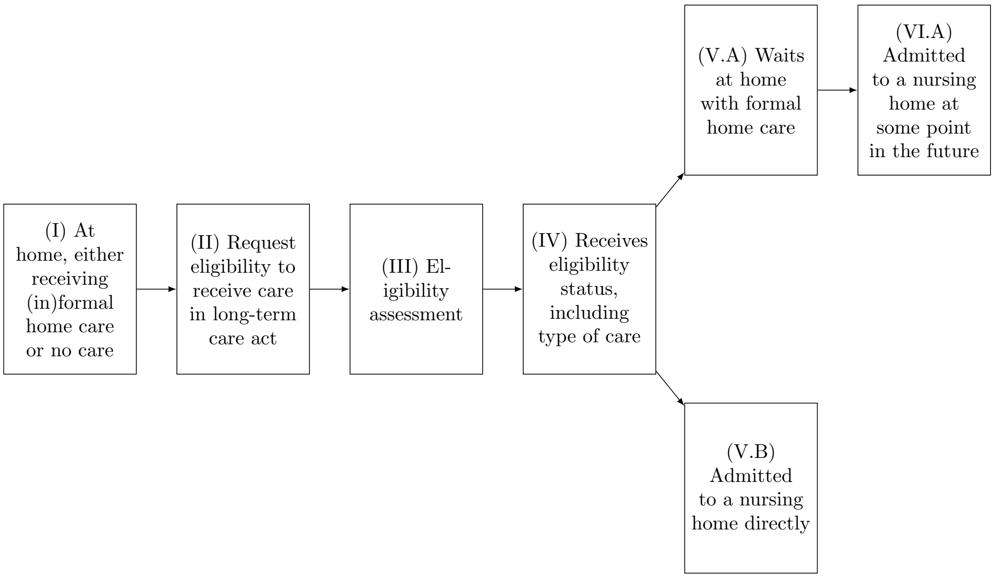
	Average costs of those who delay by:		T-test mean difference column 1 vs 2	
	0-1 month	1-2 months	Mean difference	Std. error
	(1)	(2)	(3)	(4)
Full sample				
GP care	284.5	337.5	53.1	(16.2)
Medication	615.5	875.9	260.4	(63.7)
Community nursing	483.5	853.2	369.8	(46.9)
Observations	3275	654		
Dementia care needs				
GP care	176.6	207.3	30.7	(16.3)
Medication	235.0	322.0	87.0	(37.2)
Community nursing	590.3	902.9	312.6	(57.8)
Observations	1585	329		
Moderate somatic care needs				
GP care	494.3	493.7	-0.6	(28.5)
Medication	1323.1	1364.5	41.4	(110.2)
Community nursing	375.4	642.2	266.8	(69.0)
Observations	923	259		
High somatic care needs				
GP care	254.7	373.6	118.9	(55.5)
Medication	550.1	1719.6	1169.5	(287.1)
Community nursing	392.8	1434.0	1041.1	(186.8)
Observations	767	66		

Given that we only observe an individual's costs for general practitioners care, medication and regional nursing per calendar year, we do not observe these costs in the year following eligibility. We therefore calculate the difference in these costs between individuals who spend 11-12 months of a calendar year in the nursing home to those who spend 10-11 months (one month shorter) in the nursing home. For this, we use a sub sample of individuals who receive their eligibility status in January, and compare costs of those who delay their nursing home admission by 0-1 month (i.e. admitted in January-February) to those who delay by 1-2 months (i.e. admitted in February-March). This table reports the average differences between these groups for the full sample and for each care profile separately.

Robust standard errors between brackets. *** Difference in mean is statistically significantly different from zero at 1 percent; ** at 5 percent; * at 10 percent.

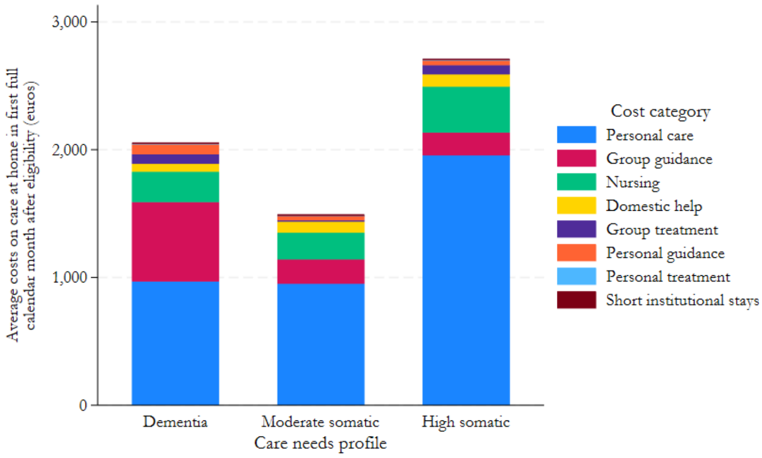
A.5 Appendix Figures

Figure A1: Process from eligibility to the nursing home admission



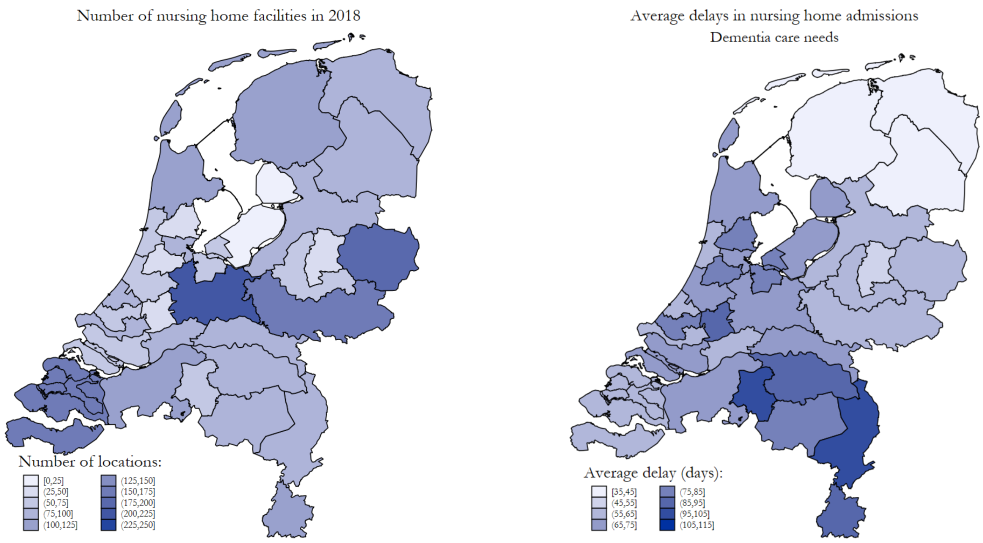
Notes: The figure demonstrates the process of applying for an eligibility status up to the nursing home admission. Eligibility can also be requested by a physician if one requires a nursing home admission after a hospitalisation. The process of such an urgent admission slightly deviates from the process depicted in this Figure in which the recipient may first receive care in a crisis facility.

Figure A2: Costs on care at home per category



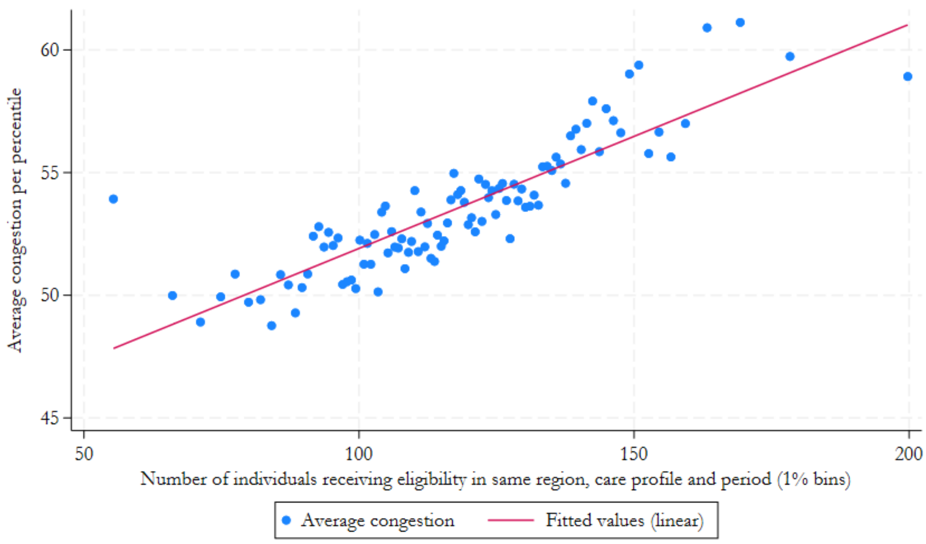
Notes: Figure shows the average costs of formal care at home in the first calendar month after eligibility, conditional on receiving care at home from a variable package (in Dutch: Modulair Pakket Thuis) for at least one calendar month after eligibility.

Figure A3: 31 care office regions (in Dutch: Zorgkantoorregio's)



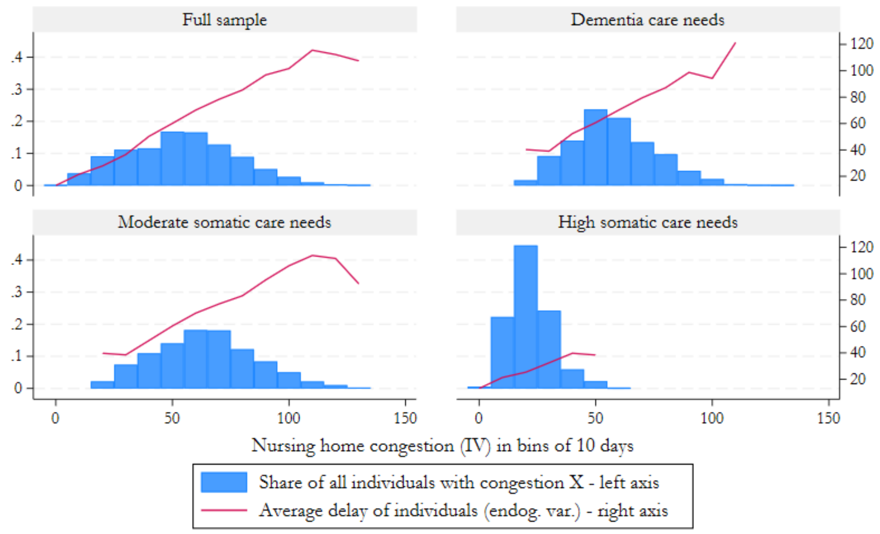
Notes: Figure shows the variation across 31 regions in the number of nursing home facilities in 2018 (left) and the average delay among people with moderate dementia care needs (right). Data on the number of facilities comes from TNO (2019) and average delays from own calculations.

Figure A4: Relationship number of individuals receiving eligibility and congestion (instrumental variable)



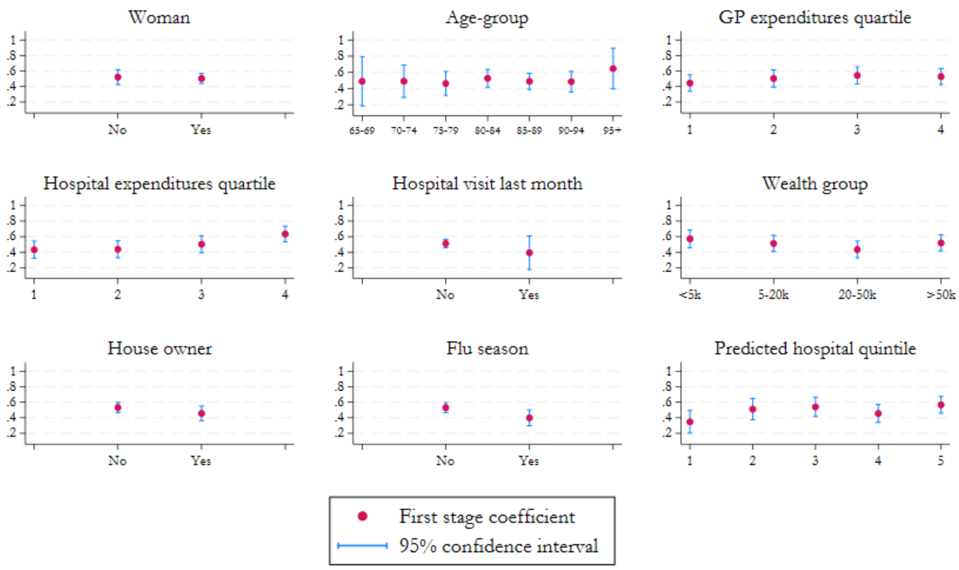
Notes: This figure divides the sample in percentiles based on the total number of other individuals becoming eligible for nursing home care in same region, same care profile and period (x-axis). It plots the average congestion (defined as average delay of other individuals becoming eligible for nursing home care in same region, same care profile and period; instrumental variable) for each of these bins on the y-axis. The estimated coefficient of the linear fit is 0.0913 (standard error 0.0019).

Figure A5: Congestion and average individual delays



Notes: Figure shows the distribution of the instrument (i.e. nursing home congestion) and the non-parametric relationship with individual delays (endogenous variable). The average delay for instrument level X is removed if it was based on fewer than 50 observations

Figure A6: First stage result by subgroup



Notes: Figure shows the first stage results for various sub-samples, composed using information on the covariates. Predicted hospitalisation quintiles are constructed by estimating a linear regression of urgent hospitalisations on all covariates, then predicting one's probability to be hospitalised using the estimated coefficients and subsequently dividing the sample into five quintiles from low to a high probability. The red dots depict the first-stage coefficient of the instrument congestion in a regression on endogenous individual delays as an outcome, with the 95 percent confidence intervals reported by the blue lines.

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