The effects of multi-disciplinary integrated care on healthcare utilisation: evidence from a natural experiment in the UK

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1 Introduction

The burden of disease worldwide is shifting to long-term conditions. Projected increases in populations aged 65 or older with multiple long-term conditions and the related increase in demand for health care are major challenges for health care systems. There is concern that current care provision is fragmented and unresponsive to the needs of (the majority of) people with multiple conditions because most health care systems and guidelines are designed around the treatment of single conditions rather than the overall treatment of condition clusters. Patients often mention frustrations due to having to visit several health care providers as a result of their multimorbidity, and having to navigate complex health care systems (Schiøtz et al. (2016), Hays et al. (2017), Rosbach and Andersen (2017)). These frustrations increase the weight of treatment burden. Health care providers also share these frustrations and are concerned about not being able to handle multimorbid patients who may have conditions beyond their specialty (Paddison et al. (2015), Sinnott et al. (2013)). In addition to the management of care, fragmented care provision increases the risk of inappropriate polypharmacy and increased use and costs of care (Kasteridis et al. (2015)). Indeed, there is evidence that the greater number of chronic conditions treated by multiple (un-coordinated) physicians, the greater the likelihood of adverse drug events (Panagioti et al. (2017), Green et al. (2007)). This is especially true for the elderly (65 years of age and older). Consequently, the current challenge is to provide integrated care for patients, and especially for those with multimorbidity.

Integrating care through organisational changes for healthcare delivery aims at improving services in relation to quality and efficiency. Integration of care could be achieved in multiple ways, for example by horizontal integration, between organisations at the same hierarchical level of healthcare (e.g. primary care providers), or by vertical integration, between organisations at different hierarchical levels of healthcare and social care (e.g. between primary and secondary care providers) (Nolte and McKee (2008)). It can also be achieved by changes at the service delivery level, changes to how patients access and use services, or for example, back-office changes to financing and contracting or organisational forms (e.g. agreed referral criteria, common assessment documents, case coordinators, staff co-location[1].

Many implemented new care models include Multi-Disciplinary Groups (MDG), as a patient-facing, easily understandable form of vertical integration. They usually involve multi-professional group meetings, sharing information, discussing and care planning for pre-identified high-risk patient cases. For multimorbid patients specifically, with no clear discrete disease combinations at which to target interventions, the multidisciplinary approach common in this setting will likely remain important rather than pathways/guidelines based on a few specific disease clusters (Stokes et al., 2021). MDGs were

[1] A strong primary care base is frequently suggested as the starting point for integrating (WHO (2016)), as a more preventative, potentially less expensive setting as opposed to secondary care (Starfield et al., 2005).

present in 60% of the case management initiative identified in Stokes et al. (2015) systematic review, and it is, by far, the most common element of new models of integrated care more generally (Baxter et al. (2018)). Likewise, a Cochrane review of interventions for multimorbid patients specifically identified MDG case management as the predominant approach (Smith and Fortin (2016). In addition, Kirst et al. (2017)'s review found that successful integrated care programmes for older adults with complex needs contained MDGs involving health professionals that trusted each other. Building this trust can be developed via regular meetings to discuss patient cases. Many integrated care programmes, including MDG interventions, have been implemented in the past twenty years. In 2009 the UK nationally funded 16 initial Integrated Care Pilots, followed by additional local initiatives (e.g. North-West London Integrated Care Pilots (Bardsley et al. (2013)), or the Integration of Social and Health Care Services for Older People in Cambridgeshire (Hu (2014)). There are also many international examples (e.g. the Model of Integrated Care and Case Management or Older People Living in the Community in Italy (Bernabei et al. (1998)), Geriatric Resources for Assessment and Care of Elders (Counsell et al., 2007) in the United States), and their number rapidly increased by the mid 2000s.

However, evidence on the efficiency of the MDG approach is limited because the majority of integrated care programmes are complex and contain multiple elements, not just the MDG elements. Frequently, their evaluation does not distinguish between each element in turn and instead evaluates as a bundle of interventions in tandem. It is often challenging to even elucidate the specific composition of each component due to limited reporting (Baxter et al., 2018). Even when MDG meetings are the core of the programme, the interventions don't always involve patient case discussions (Beacon (2015)), or are too narrowly focused on a specific medical specialty (Lamb et al. (2014)), or include extremely fragmented and heterogeneous interventions. To illustrate the later point, Windle et al. (2009) had 29 pilot sites set up 146 local projects ranging from mental Health Focused Programmes to Case Findings projects. Additionally, very little of the existing literature is able to provide convincing causal evidence of the effect of MDG on a wide range of outcomes (Lamb et al. (2014) provides descriptive statistics Beacon (2015) compares outcomes between the treated and a synthetic control group, Windle et al. (2009) uses the British Household Panel Survey as a control group).

MDG meetings are also likely to generate spillovers on patients whose cases are not directly discussed but who share similar characteristics. This spillover would be triggered by improved relationships and coordination between health care and social care providers. To capture the spillover effect of the intervention, the evaluation strategy needs to rely on data on a population that share individual characteristics with the patients treated by the intervention (Stokes et al., 2016).

This paper focuses on MDG meetings introduced as part of the Salford Integrated Care Programme (SICP), in Salford in England. The MDG intervention mainly aimed at discussing patient cases for those 65 years and older and at high-risk of hospital use. In addition, the SICP provided, to all patients regardless of their age, access to an integrated contact centre for navigation within the health and social care systems, as well as increased support and referral to community assets.

We contribute to the literature evaluating the causal impact of the MDG approach. First, we avoid the shortcomings of evaluating the intervention as a "bundle" which conceals heterogeneity in the effects of different components of the intervention. The closest papers to ours use quasi- experimental methods or randomized controlled trials (RCT). Among papers using RCT to evaluate MDG meetings, sample size did not exceed 1000 patients and the observation period was a maximum of 2 years (Stokes et al. (2015)). For instance, Engelhardt et al. (2006) evaluated the advanced illness coordinated care programme conducted in the United States for 309 patients with severe chronic diseases and hospital admissions in the last 6 months. They found no effect on mortality, but improvement in patient experience. Ródenas et al. (2008) included 152 frail older patients in a primary care centre in the Valencia region, Spain. The programme involved a multidisciplinary team providing an assessment of the individual situation with respect to health and social care before planning care changes. One year after the programme was implemented, they found no difference in hospital admission or patient satisfaction and health, but they found that patients used a more balanced combination of health care and social care resources. Overall, these studies suggest that MDG meetings have null or, at best, mixed effects on health care utilization and patient health or experience. Instead, Curry et al. (2013), used mixed methods to evaluate the process and performance within its first year of a pilot programme targeting patients over 75 years old as well as patients with diabetes in the North West of London in England. This programme involved care planning and MDG reviewing high-risk cases. The quantitative impact evaluation compared patients who benefited from a care plan developed or reviewed by a MDG, and matched control patients in a difference-in-difference framework. They found no change in emergency attendances or admissions, or total inpatient costs in the first year, but early evidence of improvements in diabetes care with no changes in other health outcomes.

We add to this literature by providing evidence of the impact of an existing and continuing programme on a larger range of outcomes across the patient pathway, and over three years follow-up. Our study also differs by focusing on the effect of MDG meetings and considers care planning and patient experience as mechanisms through which MDG may impact health care utilisation.

Furthermore, we build on a previous evaluation of the same MDG programme by Bower et al. (2018), who did not control for unobserved local factors such as the integrated contact center and development of community assets implemented at the same time in Salford as part of the SICP. We can, therefore, assume that this previous evaluation captured all three components of the SICP for people aged 65 and older for its first year of implementation (2015/2016). They found an increase in emergency admissions and a decrease in discharge to usual place of residence. We depart from their analysis by solely evaluating the effect of MDGs using the age cutoff, i.e. we also incorporate a younger age group within Salford in our controls to attempt to zero out the effects of the other two components implemented more broadly for the population. We also extend healthcare outcomes that are usually taken into account by looking at effects on planned and non-planned admission and related length of stay, outpatient visits, total cost of secondary care. We investigate the impact of integrated care on a new set of outcomes: patient experience, health status as well as primary care utilisation. Hence, we give a more complete picture of the integrated care intervention effects. We conduct a subgroup analysis on multimorbid patients to focus on those for whom we would expect consequences of integrating care to be greatest. Finally, evaluation of integrated care programs have been criticized for only considering short term effects while effects on care use and costs are likely to be visible in the medium or long term (Morciano et al. (2020) and Clarke et al. (2020)). We observe the programme's impact over 3 years. We examine the effect of MDGs (including GPs, mental health professional, social workers, geriatrists, and nurses) that meet every month to discuss 65 years and older, high-risk patient cases in the primary care (neighbourhood or community) setting. We use triple difference-in-difference models, exploiting the targeting of MDGs at people aged 65 years and over, in the Salford area, from Spring 2015 onwards. Applying this estimation strategy on national Hospital Episode Statistics (HES) and the General Practice Patient Survey (GPPS) data, we analyse how this integration initiative affects primary care (GP and nurse visits) and secondary care provision and costs as well as health status. We investigate potential channels such as changes in patient's ability to manage their care, support needs and care plan utilisation. This paper is an attempt to provide comprehensive evidence of the effect of a popular integrated care initiative, which is being increasingly adopted.

The remainder of this paper is organized as follows. Section 2 introduces background information on SICP. Section 3 and 4 respectively present data used in this paper and the empirical method. Section 5 shows the estimation results, and Section 6 discusses our results and concludes the paper.

2 Background on the English healthcare system and SICP

2.1 The English healthcare system and recent integrated care initiatives

In England, the Department of Health organises healthcare (the National Health Service (NHS)) at a national level, while the social care system is organized at a regional level, under the control of local authorities. Primary care provides ongoing care for common conditions and injuries and serves as a gatekeeper to more specialized care, secondary care, provided in hospitals. Primary care is mainly provided by practice-based general practitioners and nurses, with practices to which patient are registered. Most services are provided free of charge, but there are some that can involve cost-sharing like dental care and pharmaceuticals (Cylus et al. (2015)).

The NHS regularly undergoes re-organisations. Recent policies have hoped that improving the integration of health and social care should reduce demand for emergency care services and unnecessary hospitalizations. During the last decade, the Integrated Care and Support Pioneer programmes and the Vanguards sites (Morciano et al. (2021)) are two large national integration care initiatives in the NHS in England. In 2013, the Integrated Care and Support Pioneer programme promoted horizontal integration between the local health and social care systems by encouraging the implementation of new ways of working together. Pioneer areas were either based geographically on single or aggregations of local authorities. The new care model Vanguard programme proposed in 2014 that a number of "Vanguards" sites would be established to test new ways of providing services by breaking down barriers between different care sectors. The Salford Integrated Care Programme (SICP) is one of these Vanguards.

2.2 SICP

The intervention took place in Salford, part of the Greater Manchester region in the UK. Salford has 294,916 (34,000 aged over 65 years) inhabitants and 52 general practices. According to the Indices of multiple deprivation of 2015, Salford is the 16th most deprived local authority in England. For instance, the percentage of pupils achieving good grades in the GCSE exams at the age of 14-17 (5 or more GCSEs at grades A-C) is 49.7% in Salford relatively to 57.8% in England. A higher level of deprivation results in lower life expectancy in Salford than the national life expectancy and in higher levels of long-term illness than the national average. Life expectancy at 65 years old in England is an additional 19.8 years while in Salford it is 18.25 in 2015 (Office for National statistics). The directly standardised premature mortality rate (per 100,000 people), aged below 64 for all causes, is 456 in Salford and 334 in England (Public Health England).

The SICP was a large-scale transformation project to improve care for people with long-term conditions and social care needs. The programme provided access to (a) an integrated contact centre in which one telephone number can be called for advice on navigating the health and social care services (b) MDGs for supporting high-risk patients, (c) increasing support, recognition and referral to community assets, such as local clubs and community groups. Components (a) and (c) arguably aim at longer-term effects, providing an environment that designers hoped would prevent health deterioration and future utilization and costs. Participation in community assets in SICP improved quality of life on multiple dimensions (quality-adjusted life years, opportunities for recreation and leisure etc.) and reduced costs of care (Munford et al. (2020a), Munford et al. (2020b), Munford et al. (2017)). This paper aims at primarily evaluating the second component of the programme (b) the component that is most likely to have any short-term effects and effects on multimorbid patients. MDGs are composed of healthcare practitioners and social workers who discuss case management and plan care of the highestrisk patients. A risk assessment tool was used to assess risk of hospitalization and care home admission for population over 65 years old. The model of risk used is a slight variation (and adapted for a general public audience) of the Combined Predictive Model that is used more broadly nationally in the NHS (Wennberg et al. (2006)). Based on healthcare administrative records, this initial model isolated predictor variables associated with risk of admission such as long-term conditions, polypharmacy, as well as healthcare utilization recurrent patterns. However, Stokes et al. (2018) document that, after experiencing the risk assessment tool for a few months, MDGs started to move away from its strict use, eventually, finding that they were mostly identifying patients well-known to health care services, with little room for doing more to reduce necessary and not always preventable utilization. The selection process evolved to better target patients with actionable needs. Overall, patients whose cases were discussed are over 65 years old, and a large majority of them have at least one chronic disease. In addition, Stokes et al. (2018) report that healthcare practitioners felt patient needs were mainly related to social factors (isolation, poor housing or living arrangements etc.) and mental health conditions. It suggests that our results would be generalizable to patients with similar social and health characteristics.

In Salford, the MDGs were composed of GPs, mental health professional, social workers, geriatricians and nurses from the same neighbourhood[2]. The MDGs were jointly chaired by a social worker and a district nurse and they had administrative support[3]. The MDG composition was similar across each neighbourhood. MDGs only targeted patients that were 65 years or older and they would typically (being at high-risk for secondary care utilisation) have one or more chronic diseases. Components (a) and (c) of SICP didn't target a specific age group, but rather focused on generally improving services for all adults in the entire geographical region. Our empirical strategy takes advantage of this difference to only evaluate the effect of the MDGs on outcomes.

The MDG component began with an initial training period. The group members met a few times to familiarise and to discuss their current activities and professional habits. In this training period, mental health professionals, social workers, and district nurses also obtained access to the information stored in the electronic shared healthcare records and learned how to use them. After a few months, they started discussing patient cases. During MDG meetings, healthcare and social care professionals used their expertise to provide patients with a biopsychosocial assessment and recommended actions that would be followed through (formulating a care plan). A care coordinator[4] was then allocated to

[2]MDGs operated at the neighbourhood level including between 2 to 6 GP practices with an average of 4 per neighbourhood.

[3]As described in Bower et al. (2018), administrative and nursing leads were fully funded while social care leads were 50% funded for MDG participation and retaining caseloads for the other 50%. This meant that nursing leads had more time available for working in MDG. GPs were reimbursed for attending MDG meetings by Salford Clinical commissioning groups (CCG), with the CCG eventually agreeing to pay for 7 hours including pre- and post-work. CCGs, Clinical commissioning groups (CCGs), are NHS organisations to organise the delivery of NHS services in England.

[4]NHS care coordinator are not necessarily healthcare professionals as their role is to identify patients in needs for

each patient discussed. MDG meetings also helped professionals to share knowledge and build trust. For example, Bower et al. (2018) reported that MDG meetings were used to share perspectives and learn availability of local services. The geriatricians were particularly valued, involved in many key actions, able to access hospital patient data enriching the discussions with information not contained in the shared care record for instance, and frequently advised GPs on medication reviews.

All MDGs started discussing patient cases between March and June 2015. Six months after all neighbourhoods started the meetings (by the end of January 2016), 1651 patient cases had been discussed in the MDG meetings (Bower et al. (2018)). If we assume that the number of cases discussed did not change dramatically until the end of 2017, approximately 3300 patient's cases were discussed every year. It represents nearly 10% of the yearly population aged 65 and older in Salford[5].

3 Data

3.1 Data sources and outcomes

3.1.1 The GP Patient Survey

For measuring primary care use, health status and patient experience, we used the national GP Patient Survey (GPPS), a postal survey administered to approximately 2.15 million registered patients from all GP practices in England. The survey has been conducted twice a year from 2012 until 2015 and annually from 2016 by NHS England and Ipsos Mori. Data were collected from January to March (1st semester), and from July to September (2nd semester), and since 2016 only from January to March. The same patient may receive and send back the questionnaire at several points in time but never in the same year. However, those patients cannot be identified and followed through time. We use data from the 2012 to 2017 survey waves since previous waves were not comparable due to survey method changes. The survey provides information on patient health status, experience of care as well as primary care utilisation using self-administrated questionnaires [6]. We recorded multimorbidity defined as having two or more chronic conditions [7].

Primary care use is measured as whether a respondent of the GPPS consulted a GP or a nurse in the past year. We use EQ5D as a measure of health status.

The health status is measured using a score including five dimensions (5D); mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. We use this score as a continuous variable with the higher the score, the better the health status. Further details are provided in the Appendix A.1.

support and help them connect with health and social care services.

[5] Unfortunately, we don't know if the same patient case was discussed once or multiple times

[6] More information on the sampling method can be found for each wave at `https://gp-patient.co.uk/`

[7] Patients had to say which, if any, of a list of medical conditions they have. If they tick two or more boxes they are considered as multimorbid respondents.

Patient experience of care management is ascertained by four variables that are especially relevant for patients with multimorbidity. Patient specific care management could typically be initiated during MDGs and involve providing more appropriate health and social care advice and support to the patient. Thus, MDGs can theoretically improve patient's support and confidence in managing their chronic disease(s). We cover those aspects with a variable that takes the value 1 if the respondent answered that they are very confident in managing their own care and 0 otherwise (self-management hereafter). We use a second variable that is derived from the answer to the question "In the last 6 months, have you had enough support from local services or organisations to help you manage your long-term health conditions?" which was only asked to those who declared suffering from at least one chronic condition. The variable takes the value 1 if the respondent answered either "Yes, definitely" or "Yes, to some extent" and 0 if they answered "No". This variable excludes respondents who have not needed such support and those who don't know and hence is interpreted as receiving support conditional on needing it (Enough support in the past 6 month hereafter). In addition, we created a variable using the same question but that takes the value of 1 if the respondent answers that he/she does not need such support, and 0 otherwise, excluding those who don't know (No need of support hereafter).Lastly, patients can benefit from a care plan. A care plan sets out how patients' care and social support needs will be met by a multi-professional endeavour. The patient should be involved in the preparation of their care plan and is supposed to have a written copy. We use a binary variable that is the answer to the question "Do you have a written care plan?". This variable is only available in the second semester of 2013 onward (Having a care plan hereafter).

3.1.2 The Hospital Episode Statistics

Hospital Episode Statistics (HES) is a database recording all admissions, outpatient specialist visits, and emergency department attendances at NHS hospitals in England. The HES data cover many of the outcomes that the MDG was specifically designed to address. For example, MDGs aimed at reducing preventable exacerbation resulting in emergency care utilisation as well as reducing length of stay by improving required health and social support outside of the hospital. We first created an individual-level data set over 6 years of data (annually, financial years 2011/12 to 2017/18 - financial years start in April), counting all inpatient admissions, and emergency care attendances per individual person per year. We costed each measure of utilisation using the NHS tariff applicable in that year[8], and constructed a measure of the total cost of secondary care for each patient in each year. We record multimorbidity using a dummy variable based on a count (2 or more) of 30 long-term conditions recorded in the HES admitted patient care data (see Tonelli et al. (2015) for list of conditions and

[8]More details on National tariff payment system are available on https://improvement.nhs.uk/resources/ national-tariff-1719/

icd-10 codes). We minimised missing multimorbidity counts (for example, a year in which a patient only has outpatient contacts where multiple morbidities are not recorded) by updating data from the previous non-missing year(s).

Using the HES data, we were able to disentangle secondary care use between emergency care and planned care. Planned care admissions are planned admissions for specific medical procedures, while emergency care are unplanned attendances (e.g. coming from emergency room) that have led to hospital admissions. Specifically, we measure how many times patients received each of the following types of care by year. The outcome measures are emergency care attendances (per registered patient), admissions (per registered patient) and length of stay in days (per emergency care admission); and outpatient visits, planned care admissions (per registered patient) and length of stay in days (per admission). We also study the effect of total cost of secondary care by patient. For each outcome, we construct the two sub-outcomes which are the total number of admission or visits, as well as the probability to be admitted or to visit (at least once). We use a complementary set of secondary care utilisation measures that may specifically be affected by MDGs.

Case management should most readily reduce avoidable hospital admissions, measured by admission for ambulatory care sensitive conditions (ACSCs). Improving coordination of healthcare and social care outside of the hospital should reduce the likelihood of delayed discharge once the hospital stay is finalised, usually delayed due to the lack of coordination between hospital, social care, and other community services. It may also have an impact on the probability of not being discharged to the usual place of residence, which measures the likelihood of being discharged to a care home rather than home. Lastly, better coordination of high-risk patients should reduce the number of 90-day inpatient re-admissions (per admission), providing as much preventative/rehabilitative care as possible in the community rather than hospital setting.

Figure 1 summarizes the utilisation measures considered in this paper. Health status is the ultimate outcome resulting from improved care utilisation. Patient experience outcomes are channels through which MDGs can impact health status[9], primary and secondary care outcomes.

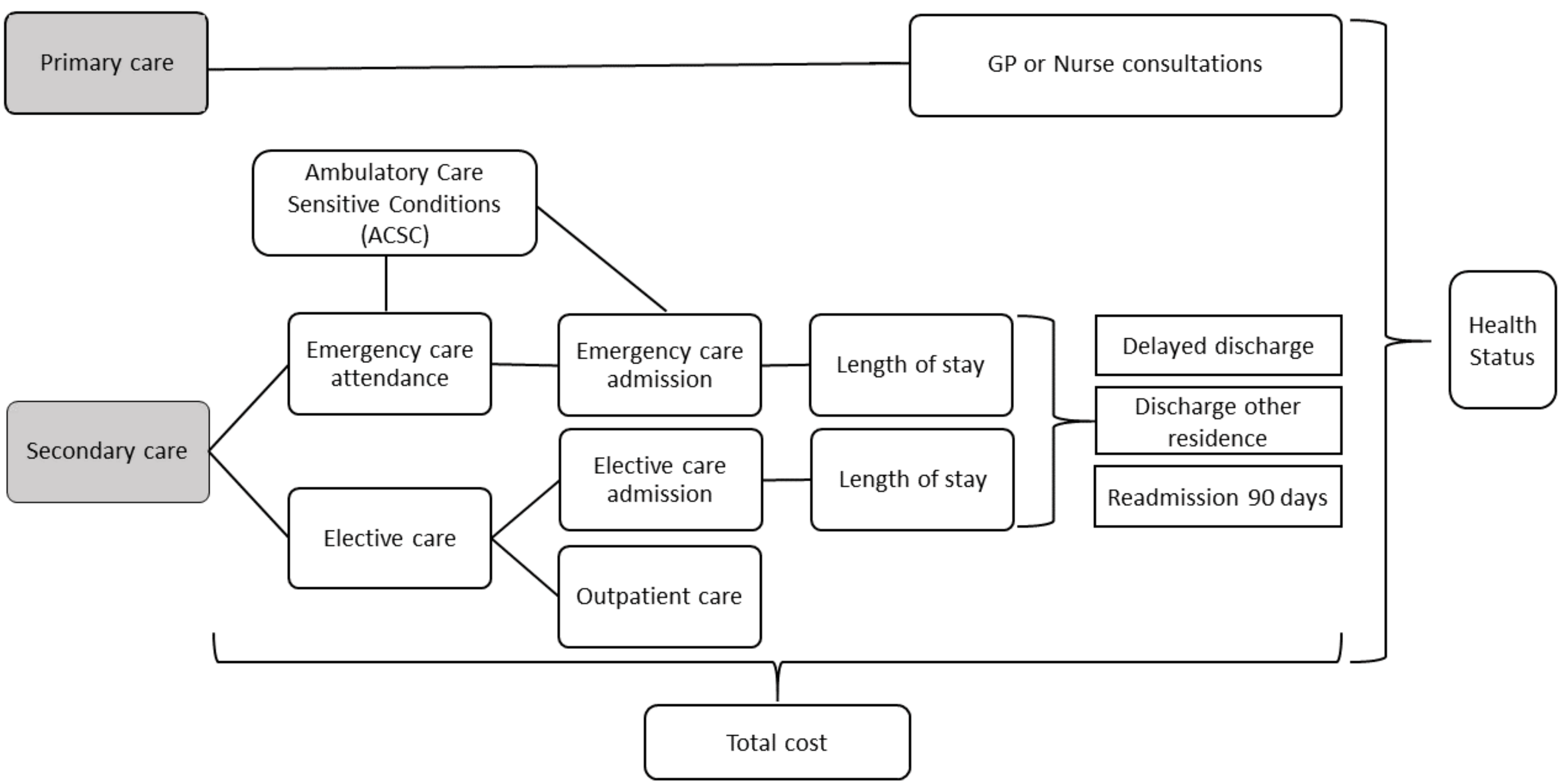
[INSERT Figure 1]

3.1.3 GP practice characteristics

We also use GP practice time-varying characteristics provided for each year by NHS Digital such as practice size, the proportion of patients above 75 years old, the number of full-time equivalent doctors,

[9] MDGs are also potentially able to directly affect health, e.g. through medication review, rationalising the number of visits made to multiple professionals to a more generalist (e.g. geriatrician), which would then impact on subsequent healthcare utilisation. In this case, health status would be considered as a mechanism.

Figure 1: Outcomes measured using the GP practice survey and Hospital Episode Statistics data



and the level of socio-economic deprivation in the areas of residence of the practice (See Appendix A.1 for more details).

We minimise missing values in each year by updating data from the previous or next non-missing year. The only practices missing from each sample are those for which we were unable to collect practice characteristics from NHS Digital and none of them are in Salford.

4 Method

4.1 Estimation strategy

The experimental variation in our data allows us to estimate the effect of the MDGs on several outcomes.

Let T_t^k be the outcome for practices in Salford, and C_t^k be the outcome for practices outside, i.e., the control group. The superscript k indexes two types of practices: those for which outcomes are measured for individuals older than 65 years old (65) and those younger than 65 years old ($\underline{65}$). The subscript t indexes two time periods. The pre-period (t=0) consists of the time between 2012 and March 2015, before the MDGs started discussing patient cases; the post-period (t=1) consists of data from second semester of 2015 and 2017, when the MDGs were in place.

Using this notation, a simple cross-sectional estimate of the average effect of the MDG can be obtained by comparing the outcome for the target practices in Salford in the two periods of time:

$$\Delta = T_1^{65} - T_0^{65} \tag{1}$$

This estimate assumes that no unobserved factors coinciding with the intervention timing would affect individuals' outcome. This assumption is unlikely to hold. To improve this estimate, we will compare the effect of change in time for practices in Salford where MDGs were established, with the corresponding change for those in the rest of England which did not introduce MDGs at the same time. By implementing this difference-in-difference estimate, we account for the time-varying observed and unobserved factors affecting similarly Salford and the rest of England. The equation would be:

$$\Delta\Delta = (T_1^{65} - T_0^{65}) - (C_1^{65} - C_0^{65}) \tag{2}$$

Unobserved local factors remain a potential source of bias. Indeed, the SICP has established 2 other interventions at the same time in Salford. The two other interventions targeted everyone, while MDGs only targeted those age 65 and older. This potential bias can be eliminated by using a triple difference-in-difference estimator based on age groups as shown in equation 3.

$$\Delta\Delta\Delta = (T_1^{65} - T_0^{65}) - (C_1^{65} - C_0^{65}) - (T_1^{\underline{65}} - T_0^{\underline{65}}) - (C_1^{\underline{65}} - C_0^{\underline{65}}) \quad (3)$$

We limit our main analysis sample to individuals age 45 and older. This lower bound in our sample aims at excluding younger respondents who may be different from those age 65 and over in terms of healthcare needs and consumption. Hence it may not be a suitable control group for those older than 65. To summarize, we augment the standard difference-in-difference model by estimating a difference-in-difference-in-difference specification because our control structure is threefold:

1. cross-sectional over regions: Salford versus the rest of England
2. temporal over years: the pre-period is between January 2012 and the first semester of 2015 and the post period starts in the second semester of 2015 onwards.
3. between individuals: the MDG targeted individuals aged 65 and over.

The triple difference estimate can be obtained from the following regression estimate:

$$y_{i,t} = \alpha_1 Salford_i + \alpha_2 Over65_i + \alpha_3 Post_t + \beta_1 Salford_i \times Age65_i + \beta_2 Salford_i \times Post_t + \beta_3 Over65_i \times Post_t + \gamma Salford_i \times Over65_i \times Post_t + \theta X_{i,t} + \delta T_t + \sigma P_i + \epsilon_{i,t} \quad (4)$$

In this equation *Salford* is an indicator variable that equals one for practices in Salford, *Over65* is an indicator for the segment representing those aged 65 and over, the indicator *Post* equals one for periods of the second semester of 2015 onward. The estimate of the triple difference is γ. X is a vector of control variables including time-varying GP practice characteristics such as GP practice list size, the number of full-time equivalents, the proportion of registered patient over 75 years old, and the multi-deprivation index. As each observation is a combination for each practice of gender, being over 65 of age and multimorbidity in each time period, we control for each of these characteristics by adding a segment fixed effect (P) and time fixed effects (T)[10]. This accounts for GP practice time-invariant characteristics as well as time trend. Errors are clustered at the GP practice level. Although we can't identify in our data which patients had their cases discussed, we conducted a subgroup analysis on multimorbid patients in order to be as close as possible to those that are directly targeted by the programme. Lastly, we estimate all models using linear probability models.

The timing of both data sources is well-suited for our study for three reasons. First, we have 3.5 years of GPPS data before (from the 1st semester of 2012 to the 1st semester of 2015) and 2.5 years after (from the 2nd semester of 2015 to the end of 2017) the implementation of the intervention that occurred between March to June 2015. For the HES data, the start of financial year 2015/2016 coincides with

[10] The only time indicator available in the GPPS data is the survey wave. It means that for pre-2016, we include semester fixed effects, and for post-2016, we include year fixed effects.

implementation of the intervention, giving us 3 years of pre-intervention data and 3 years of post data. This facilitates clear comparisons during the pre-period and simplifies the implementation of the triple difference-in-differences model to estimate the effect of MDGs. Second, using individual-level data from each source, we created two datasets[11] where each observation represents one of eight segments of each GP practice (combinations of presence of multimorbidity, aged over 65 years, and gender) at each time point (by survey wave and adjusting for survey weights for GPPS and annually for HES). For example, one row of data represented the outcomes for multimorbid patients, aged 65 years and older, and male (with eight possible unique combinations of these three variables), in GP practice P at time t.

Therefore, we can exploit the panel dimension of our datasets which will allow us to control for practice time-invariant characteristics that may affect our outcomes. In addition, we only keep practices that are in our dataset from 2012 to 2017 to avoid any time-varying change in composition with closing or opening practices. Note that the number of practices in the GPPS and HES data differ since not all outcomes were measured in all GP practices in England, while all practices are included in the HES data. Third, we decompose the effect by year over the 3 year post period to examine any heterogeneity in effects over time.

4.2 Potential threat to identification and robustness testing

Three features could damage our identification strategy. First, within the integrated contact center which is part of the SICP, an intervention providing health coaching to 504 multimorbid aged 65 and over was tested in a RCT setting between November 2014 and February 2015. The participants were offered 6 telephone sessions of health coaching (treatment control, healthy diet, physical activity and mobility etc.), but only 189 received one phone call and 167, 4 or more calls. The evaluation of this intervention shows that health coaching did not lead to any significant improvement in terms of patient activation or quality of life (Panagioti et al. (2018)). We believe this health coaching intervention is not a concern because so few patients took it up and differences on outcomes were not statistically significant. Furthermore, we check robustness to dropping 11 GP practices in which most (70%) of the patients targeted by the health coaching intervention were registered. We also test if our results are affected if we drop the year before the intervention took place. MDGs started to meet before they started discussing patient cases in order to get to know each other. This learning process could have impacted management of care during the pre-period.

Second, other integrated care programmes were initiated in England. With "integration" a popular policy, other areas (either CCG or GP practices) likely introduced some integrated care programs

[11] HES and GPPS data are not linked across patients and differ in sample size so we have two separate datasets.

among which some had MDG meetings (although this policy information is not well recorded). To our knowledge, no paper or report mentions that only 65 and older individuals were targeted by a programme started in 2015, the majority aimed generally at "high-risk" patients. To limit this possibility, we systematically drop all CCGs that were included in the Vanguard New Care Models (except Salford) as they received additional funding to serve as testing prototypes for integrated health and social care services and were implemented at the same time as the Salford policy. We also use the 10 closest CCGs to Salford according to the NHS (called Rightcare CCGs by NHS England) as an alternative control group that is more homogeneous in terms of population and healthcare services than the rest of England. The NHS matches CCGs (in our case Salford), with CCGs that have similar weightings based on 12 variables[12].

Third, one limit of our analysis is the three years pre-period due to constraints in GPPS data consistency in older waves. In our main analysis, we maintain pre-period length consistent across our two data sources, but in a robustness check, we extend the pre-period from the HES data to financial years 2009-2014 instead of 2012-2014.

Given the large number of outcomes in this study, we consider statistical significant at the 5% level.

4.3 Matching and parallel trends

We employed propensity score weighting proposed by Stuart et al. (2014) to ensure comparability of treatment and control units. This is similar to Inverse Probability of Treatment Weighting (IPTW), but adapted to the difference-in-difference setting. This strategy weights the 4 groups (Salford pre-period, Salford post-period, Control pre-period, Control post-period) to be similar on a set of key characteristics (GP size list, the number of full time equivalent, the proportion of patients over 75 and the Multi-deprivation Index). Each group reflects the covariate distribution in Salford during the pre-period, thus removing biases due to differences in covariate distributions between the four groups. Table A.5 in the Appendix A.3 shows GP practice characteristics in Salford and the rest of England with and without weighting. In the pre-period, GP practices systematically differ, but this difference is not statistically significant once practices are weighted.

Our strategy for estimating the effect of the intervention relies on the assumption that the post period outside of Salford represents an appropriate counterfactual for those targeted by the programme (those in Salford). A standard way to test that assumption is to examine whether outcomes for the two groups were trending similarly before the programme was put in place. We test if there is any differentiated impact of being in the treatment (Salford and over 65) compared to the control group for each time

[12]overall deprivation; health deprivation; total population; under 5s; 5-14 years; 15-24 years; 75+; ADSONS – a ratio between the total GP registered patients compared to population estimates in the LSOAs where CCG's registered patients live; average population density; population density slope – gradient of the population density over LSOAs where CCG's registered patients live; % Black; % Asian.

point in the pre-period compared to the last time period before the intervention (2014 in HES data or fist semester 2015 in GPPS data). We interacted the treatment variable (Salford x over65) with the time variable in the pre-period and tested the joint hypothesis that none of the interacted terms are different from zero. We report the P-values of this test for each outcome in Table A.4 in the Appendix A.3. None of them are statistically significant at the 5% level which provides some evidence that we cannot reject the parallel trends assumption, i.e. the parallel trend assumption appears to hold. Graphical evidence of plotted coefficients in the pre-period is available in Figures A.2 and A.3 and discussed in the Appendix A.2.

5 Results

5.1 Summary statistics

Table 1 presents each weighted outcomes and mechanisms measured in the pre-period, separately for Salford, and the rest of England, over and below 65 years old. As expected, primary and secondary care utilisation is higher among the older age group and for most outcomes it is higher in the more deprived Salford practices than in the rest of England. For instance, the length of stay after emergency care per admission is 6.5 days in Salford among those aged 65+, while it is 4.4 days outside of Salford. Hospital admissions of patients below 65 years old are related to more severe diseases or injuries that would induce more readmission within 90 days and discharge to care rather than home, compared to those above 65 years old. It is also possible that the lower likelihood of readmission for those above 65 is due to mortality selection. Interestingly, more respondents above 65 years old report benefiting from enough support in the past 6 months, and having no need of support. **[INSERT TABLE 1 HERE]**

5.2 Regression results

In Tables 2 and 3 we report our estimate of interest (γ from equation 4). For each outcome, the first specification is a pooled OLS, the second adds individual fixed effects (for each segment of each practice), and the last one adds time fixed effects as well as time-varying practice characteristics. The fourth specification uses a sample restricted to the multimorbid practice segments. Our results are not sensitive to the chosen specification. This is explained by the fact that the matching is quite efficient so the additional covariates are just providing an additional layer of robustness.

Results presented in Table 2 show that MDGs decreased nurse visits in the past 12 months by 3% points. Table 3 documents the effect of MDGs on secondary emergency and planned care pathways. MDGs decrease the length of stay by emergency care admission by 1 day. In addition, we observe a

Table 1: Summary statistics

	Pre-period - Below 65			Pre-period - Over 65		
	England	Salford		England	Salford	
Primary care use			P-value			P-value
GP 1 year	0.890	0.910	0.020	0.927	0.920	0.963
	(0.146)	(0.126)		(0.134)	(0.136)	
Nurse 1 year	0.720	0.756	0.000	0.881	0.924	0.000
	(0.241)	(0.223)		(0.181)	(0.133)	
Secondary care use						
Emergency care						
Nb of emergency care attendance	0.331	0.374	0.000	0.528	0.524	0.681
	(0.163)	(0.129)		(0.273)	(0.169)	
At least an emergency care attendance	0.176	0.199	0.000	0.309	0.316	0.144
	(0.0865)	(0.0797)		(0.152)	(0.121)	
Nb of emergency care admission	0.111	0.133	0.000	0.275	0.291	0.009
	(0.0776)	(0.0874)		(0.151)	(0.137)	
At least an emergency admission	0.0658	0.0781	0.000	0.174	0.181	0.003
	(0.0319)	(0.0353)		(0.0736)	(0.0544)	
Length of stay (days) after emergency admission	2.933	3.854	0.000	4.402	6.531	0.000
	(3.523)	(3.309)		(4.403)	(3.079)	
Planned care:						
Nb of planned care admission	0.168	0.182	0.130	0.487	0.483	0.812
	(0.186)	(0.210)		(0.500)	(0.406)	
At least an planned care admission	0.0691	0.0731	0.000	0.224	0.220	0.461
	(0.0271)	(0.0233)		(0.131)	(0.115)	
Length of stay (days) after planned care	0.993	1.497	0.104	0.986	1.022	0.523
	(3.452)	(7.089)		(2.776)	(1.233)	
Other secondary care outcomes						
Readmission within 90 days/admission	0.126	0.135	0.004	0.0995	0.0939	0.077
	(0.0715)	(0.0751)		(0.0751)	(0.0718)	
Proportion of not discharged in their usual residence	0.592	0.586	0.515	0.545	0.538	0.339
	(0.203)	(0.193)		(0.156)	(0.156)	
Proportion of delayed discharge	0.0255	0.00140	0.004	0.0105	0.00407	0.122
	(1.548)	(0.0201)		(0.242)	(0.0648)	
Nb of ACSC admissions	0.0207	0.0241	0.001	0.0514	0.0527	0.409
	(0.0195)	(0.0226)		(0.0424)	(0.0358)	
Total cost per patient	478.1	531.6	0.000	1444.8	1488.2	0.017
	(250.5)	(271.9)		(548.2)	(404.9)	
Health status	0.745	0.726	0.006	0.687	0.683	0.143
	(0.217)	(0.229)		(0.180)	(0.176)	
Patient experience						
Self-management	0.382	0.413	0.005	0.362	0.402	0.000
	(0.236)	(0.233)		(0.251)	(0.255)	
Having a care plan	0.0436	0.0411	0.878	0.0641	0.0537	0.189
	(0.116)	(0.108)		(0.138)	(0.123)	
Enough support in the past 6 months	0.784	0.830	0.000	0.891	0.903	0.026
	(0.288)	(0.257)		(0.221)	(0.193)	
No need of support	0.0746	0.0800	0.297	0.157	0.157	0.533
	(0.122)	(0.127)		(0.173)	(0.174)	

Note: P-values correspond to the difference in outcomes between the Rest of England and Salford.

small decrease in the probability to be discharged to care home (as an alternative to their usual place of residence). Moreover, MDGs increase the number of outpatient visits by 0.44 visits, as well as the probability to be admitted for elective care by 2.2%. Restraining our sample to multimorbid patients shows that this sub-population is driving our results for nurse consultation in the previous year, length of stay after emergency care and the number of outpatient visits. It suggests that only patients without any or only one co-morbidity see their probability of elective care admission increased and they are also less often discharged in care home. However, this does not translate into variation in health status.
None of the patient experience measures are affected by MDGs.

We replicate our main analysis but decompose the effect by year in the post period in Figures A.4, A.5 and A.6 in Appendix A.3. The point estimates of the effect of MDGs on nurse visit and elective care are not statistically significant, except when considered all together. While the effects on the length of stay and outpatient care started in the short term and are maintained in the longer run, the effect on the place of discharge only materialises in 2017.

[INSERT TABLE 2 HERE]

[INSERT TABLE 3 HERE]

5.3 Robustness checks

We conducted a number of robustness checks presented in Table A.6 and A.7 in Appendix A.3. To ease the comparison, we add the results of our main model in the first column. We do not observe any change in our results when we dropped 2014 for secondary care outcomes, and 2015 S1 for primary care outcomes, health status and patient experience. No learning process seems to have impacted management of care during the pre-period. Second, we drop out of the sample practices that were involved in the Health Coaching part of the SICP programme to avoid any confounding effect since this intervention targeted people aged 65 and more. It does not affect our results. The only exception is that the point estimate for having visited a nurse in the past year becomes not significant, but the magnitude of the point estimate is close to the one in our main model. Third, the results remain similar when we use an alternative control group based on areas that have similar characteristics to Salford. Fourth, we extended the pre-period to 2009 using the HES data for the secondary care outcomes. Note that this corresponds to a smaller sample of practices because we only keep in the sample those opened from 2009 to 2017[13]. Point estimates remain quite close to those of our main model. The increase in cost and in ACSC admissions becomes statistically significant as they are more precisely estimated. We therefore conclude that our findings are robust to various specification changes.

[13] Pre-trend graphs for all outcomes are available in Appendix A.7 and discussed in section A.2.

Table 2: Regression results for primary care outcome, health status and patient experience

	Full sample									Multimorbid sample		
	(1)			(2)			(3)			(4)		
	Coef.	SE	Obs.	Coef.	SE	Obs.	Coef.	SE	Obs.	Coef.	SE	Obs.
Primary care												
GP 1 year	-0.001	(0.010)	421,222	-0.001	(0.010)	421,222	-0.001	(0.010)	420,522	-0.007	(0.013)	177,563
Nurse 1 year	-0.029*	(0.015)	421,105	-0.030*	(0.015)	421,105	-0.030*	(0.015)	420,405	-0.053**	(0.017)	177,480
Health status	-0.002	(0.011)	335,184	-0.001	(0.011)	335,184	-0.000	(0.011)	334,657	0.009	(0.020)	140,856
Patient experience												
No need support	0.001	(0.012)	421,370	0.001	(0.012)	421,370	0.002	(0.012)	420,670	0.025	(0.023)	177,654
Support in 6 months	0.002	(0.017)	390,719	0.001	(0.017)	390,719	0.001	(0.017)	390,083	-0.001	(0.025)	172,479
Have Care plan	0.008	(0.012)	294,531	0.006	(0.011)	294,531	0.005	(0.011)	294,082	-0.001	(0.023)	124,114
Self-management	0.008	(0.015)	421,370	0.008	(0.015)	421,370	0.008	(0.015)	420,670	-0.003	(0.031)	177,654
Segment*Practice FE	No			Yes			Yes			Yes		
Time-varying factors	No			No			Yes			Yes		

Note: Coefficients and clustered standard errors at the practice level in parentheses. ** $p < 0.01$, * $p < 0.05$. Each coefficient is associated with the triple interaction Salford X Post X Over65. Time-varying factors are year dummy, the number of full time equivalent, the proportion of patients over 75, indices of multiple deprivation and GP practice size. There are 8 combinations of each segment (male/female, over or under 65 and multimorbidity or not) by practice, for a total of practices that varies with each outcome (ranging from 4876 to 5258 practices). Segment * practices corresponds to 8 times the number of practices.

Table 3: Regression results for secondary care use

	Full sample						Multimorbid sample	
	(1)		(2)		(3)		(4)	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Emergency care:								
Nb of emergency care att.	0.003	(0.013)	0.003	(0.013)	0.003	(0.013)	-0.001	(0.024)
Pr. emergency care att.	0.004	(0.005)	0.004	(0.005)	0.004	(0.005)	0.001	(0.009)
Nb of emergency adm.	-0.001	(0.009)	-0.001	(0.009)	-0.001	(0.009)	-0.007	(0.017)
Pr. Of emergency adm.	0.002	(0.004)	0.002	(0.004)	0.002	(0.004)	-0.002	(0.008)
Length of stay by adm	-1.068**	(0.240)	-1.068**	(0.240)	-1.068**	(0.240)	-1.042**	(0.291)
Planned care:								
Pr. outpatient visit	0.003	(0.008)	0.003	(0.008)	0.003	(0.008)	-0.004	(0.012)
Nb. of outpatient visit	0.435**	(0.113)	0.435**	(0.113)	0.435**	(0.113)	0.583**	(0.209)
Nb elective care adm.	-0.044	(0.049)	-0.044	(0.049)	-0.044	(0.049)	-0.147	(0.083)
Pr. of elective care adm.	0.022**	(0.005)	0.022**	(0.005)	0.022**	(0.005)	0.001	(0.007)
Length of stay by adm.	0.206	(0.180)	0.206	(0.180)	0.206	(0.180)	0.247	(0.229)
Other secondary care:								
90 days readm. by adm.	0.006	(0.005)	0.006	(0.005)	0.006	(0.005)	0.010	(0.007)
Discharged in care home	-0.013*	(0.005)	-0.013*	(0.005)	-0.013*	(0.005)	0.002	(0.009)
Delayed discharge by adm.	0.018	(0.017)	0.018	(0.017)	0.018	(0.017)	0.009	(0.013)
Nb. ACSC adm.	0.005	(0.003)	0.005	(0.003)	0.005	(0.003)	0.006	(0.005)
Total cost by patient	59.300	(37.613)	59.300	(37.612)	59.300	(37.613)	-46.623	(70.109)
Obs.	313,392		313,392		313,392		156,696	
Nb. Segment * practices	52,232		52,232		52,232		26,116	
Segment*practice FE	No		Yes		Yes		Yes	
Time-varying factors	No		No		Yes		Yes	

Note: Coefficients and clustered standard errors at the practice level in parentheses. ** $p < 0.01$, * $p < 0.05$. Each coefficient is associated with the triple interaction Salford X Post X Over65. Time-varying factors are year dummy, the number of full time equivalent, the proportion of patients over 75, indices of multiple deprivation and practice size. There are 8 combinations of each segment (male/female, over or under 65 and multimorbidity or not) by practice, for a total of 6,529 practices. Nb. Segment * practices corresponds to 8 times the number of practices.

6 Discussion

Summary of findings:

Despite widespread utilisation, evidence on the effect of MDG meetings alone on the entire care pathway is lacking. This paper evaluates such an integrated care programme that established monthly multidisciplinary meetings as part of a larger programme including a single contact hub and an initiative to enhance social support in the community in Salford. MDG meetings targeted patients who are 65 years old and over while other features of the programme did not, targeting more widely improvements for the general population. We take advantage of this age difference to disentangle the effect of multidisciplinary meetings using triple difference-in-difference model. Our results show that primary care is solely impacted by a limited reduction in nurse visits. It may be that some of these are more easily transferred to other services such as social care. The impact on secondary care is mixed. The programme decreased hospital length of stay after an emergency admission by 1 day. This has to be put in perspective of the low-performance of Salford on length of stay in the pre-period (6.5 days for those aged 65 and over) compared to the rest of England (4.4 days for those aged 65 and over). MDGs bring the length of stay closer to the national average. In addition, we observe a small decrease in the probability to be discharged to a care home (as an alternative to their usual place of residence). These two results can be explained by better care and support coordination after hospitalization. We also find an increase in the number of outpatient visits and the probability to ever receive elective care. Discussion of high-risk patients by MDGs improves the identification of unmet needs, which results in planned consultations at the hospital to address diagnosed health issues. We speculate that those health issues were serious since they led to hospital admissions. An increase in planned care admissions by patients could eventually imply long-term health status improvement. However, this is not what we observe using EQ5D to capture health status, at least over the observed period. We observe no effect of MDG meetings on length of stay after elective care admissions. Whereas elective admissions are planned from the way in to the way out and they may have already been managing them efficiently, emergency admissions are less predictable on the way in, so there may be more opportunity for delays on the way out. These delays have been reduced by MDGs. The one-day reduction of length of stay after emergency admission may be explained by a better targeting of patients once they are in the hospital, rather than relying on identification of patients through prediction models that were unlikely to be completely accurate at an individual-level. MDGs may, therefore, have allowed care coordinator and social workers to intervene more effectively to get patients out of the hospital quicker.

Our results also suggest that the total change in secondary care has no impact on total cost of secondary care per patient. However, none of those healthcare utilisation change had an impact on health status. Furthermore, the decrease in length of stay after emergency admission as well as the increase in out-

patient care are driven by the multimorbid population, but the increases in probability of elective care and decreases in discharge to a care home were not present in the multimorbid stratification. This perhaps suggests these latter outcomes were less amenable to change for this likely more severe population. Although the multimorbid population may have been the focus of this programme, our results suggest that there is effect over other groups initiated by improved communication and shared information among health professionals of the same neighbourhood.
Finally, none of our measures of patient experience are impacted by MDG meetings.

Strengths and limitations:
We have examined the effect of MDGs introduced in Salford, but only for people aged 65 and over, enabling us to pick out this single intervention. Although this is a very common and popular integrated care policy, the impact over three years of MDG meeting targeting high-risk patients has never been evaluated independently of other integrated care initiatives implemented simultaneously. There is a legitimate debate as to whether the randomized controlled trial is optimal for the assessment of such programmes, given the likely impact of context (e.g. medical density and pre-existing relationships between physicians and social care services) and spillover effects that may complicate evaluation. We evaluated the impact of MDG meetings using quasi-experimental methods. Due to the "natural setting" of this evaluation, we were able to measure the effects on patients whose cases were directly discussed, but also other patients who share similar characteristics and hence benefited from the improved trust and communication induced by MDG regular meetings. Our results are relevant for disadvantaged localities with a high share of people with chronic diseases. We measure an average effect over multiple neighbourhood which encompasses healthcare professionals with a variety of engagement and experience in multi-professional collaboration. Therefore, our results yield external validity to similar contexts. Furthermore, in using two sources of data to measure primary care, patient experience and health status, as well as secondary care, it was possible to explore the entire care pathway and get a more nuanced picture of where the effects are occurring. The large scope of secondary care outcomes is especially important as reduction of utilisation seems to be the primary policy goal. Our results were robust to restricting the control group to CCGs that share similar socioeconomic characteristics with Salford, and to dropping GP practice that were simultaneously involved in a Health Coaching program, as well as extending the pre-period length. Our main results remained qualitatively similar in all cases, and we concluded that our main findings were not sensitive to the choice of control groups. Our analysis was, however, reliant on GPPS survey respondents. Although we use survey weights in the construction of our dataset, we cannot completely rule out the possibility that this data does not fully capture the extent of the effect of MDGs on patient experience, health status, and primary care utilisation. For instance, very high-risk patients may be unable to fill in a survey such as the

GPPS and hence many of those directly treated might have been missed by this survey. Further, we don't capture the direct MDG time and cost in this setting which may overweight primary care costs reduction driven by a decrease in nurse visit. We can't, unfortunately, measure potential transfer of primary care to social care. The results that we observe can be interpreted as direct and spillover effects of MDG meetings. We can't distinguish between the direct and spillover effects because we are in an intention-to-treat perspective where we don't know which patient cases were directly discussed during the MDG meetings. Furthermore, even if Bower et al. (2018) qualitative work reports that MDG composition remained unchanged in the early implementation stage of MDG, there is no data on the exact team composition and frequency of MDG meetings over the entire observation period. Variations in team composition and meeting frequency could lead to treatment heterogeneity that we are unable to capture.

All other contemporaneous MDG initiatives, developed through the Vanguard funding, have been accounted for by excluding the CCGs which received these funds from the analysis. However, the Pioneers programmes, some of which also included MDGs, were launched in 2014 in England. They did not all map to a single set of health or local government administrative boundaries (Keeble et al., 2019) which prevents us from precisely identifying and then excluding them. We believe that this should not be a major concern, however, because the Pioneers partially overlapped the Vanguards (10 sites out of 25 according to Erens et al. (2017)), and even if some of them include MDG they didn't specifically target patients aged 65 and over. Finally, our quantitative analysis describes patterns of healthcare use. Qualitative analysis would improve our understanding of the pathway through which integrated care might affect healthcare and social care use.

<u>Contribution to the literature:</u>

This paper contributed to several aspects of the literature. We find a small but robust reduction in nurse consultation that is consistent with potential shift from health to social care as in Ródenas et al. (2008). Our results on emergency care utilisation are in line with previous causal short-term evaluations of MDG meeting (Curry et al. (2013) for instance) as we find no effect on emergency attendances and admissions. Extending our emergency care utilisation outcomes allows us to observe a decrease in length of stay. Although our findings fit with results from a wider literature on evaluation of integrated care targeting high-risk patients which find increased utilization of planned care (Baxter et al. (2018), Stokes et al. (2016), Lloyd and Steventon (2017), Martin Roland et al. (2012) and Parry et al. (2019)), this has never been demonstrated for MDG meeting alone. Besides, these papers usually find an increase in cost, which we don't for secondary care utilisation.

Our analysis also complements previous evaluation of the SICP by focusing on one of its components. We believe the previous evaluation of MDG meeting in Salford by Bower et al. (2018) did not disentangle

between all three components of SICP and was restricted to hospital utilisation outcomes during the early implementation time period. Hence, the only relevant comparison is with hospital utilisation data in 2015. They find an increase in emergency admissions using a lagged dependent variable model. However, this result is not robust to adopting a difference-in-difference method and hence yields the same result as us with more comparable methods. The authors also observe a decrease in the proportion of patients discharged to their usual place of residence. Improved care coordination to discharge patients into care rather than their own home, may have been fostered by the integrated contact center for navigation support and coordination of SICP, and not by MDG meetings.
Our study also relates to Panagioti et al. (2018) and Munford et al. (2020b)'s paper which evaluate other components of the SICP.

Implications for policy and practice: As opposed to pilot programmes previously evaluated, the SICP is still ongoing. Our results are directly relevant to programme managers and health or social care professionals participating in the MDG meetings. From an efficacy perspective, MDG meetings are presumably fulfilling public health objectives by decreasing length of stay after emergency care use and detecting previously unmet needs. Taken together, our results show that secondary care costs are unaffected. Primary care costs would be, at best, marginally decreased by nurse visit reduction, while time and resources spent directly on case management would certainly increase primary care and social costs. The effect of MDG meetings on health system cost is, therefore, uncertain. It was not possible to isolate a significant independent cost-saving impact from the MDGs in SICP. This is consistent with other research suggesting that whilst more integrated care can affect healthcare utilization, it is unlikely to be successful as a cost-saving measure. The generalization of this result is restricted by contextual factors in Salford, such as the nature and availability of other health and social services, existing relationships between health professionals within neighborhoods, and population characteristics. Our contribution to this literature is to disentangle the effect of single policies from a global programme changing many aspects of the health and social care provision. This approach may be useful to public decision makers under budget constraints who need to select a single intervention for integrating care.

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A Appendix

A.1 Data

Care plan: Care decisions made during the MDGs would be recorded in a patient's existing care plan or a care plan may be created following the MDGs if the patient did not have one previously. Having a care plan should help the patient to live independently, and have as much control over their care and life as possible.

EQ5D: The mobility dimension asks about the person's walking ability. The self-care dimension asks about the ability to wash or dress by oneself, and the usual activities dimension measures performance in "work, study, housework, family or leisure activities". The pain/discomfort dimension asks how much pain or discomfort the person experiences, and the anxiety/depression dimension asks how anxious or depressed they are. The respondents' self- rate their level of severity for each dimension using a five-level (EQ- 5D-5L) scale. The EQ5D measure only included the three-level (EQ-5D-3L) scale for those interviewed in 2012. Hence we only use this measure from 2013 onwards. Once the health status is assessed, the 5-digit number (composed of the score for each dimension) can be converted into a single weighted index score using the value set derived by Van Hout et al. (2012)'s mapping algorithm from the initial values of Dolan (1997)'s scoring system.

Ambulatory care sensitive conditions (ACSC) are conditions where hospital admissions may be prevented by interventions in primary care (Purdy et al. (2009)). More information can be found https://digital.nhs.uk/data- and-information/data-tools-and-services/data-services/innovative-uses-of-data/demand-on-healthcare/ambulatory-care- sensitive-conditions.

Delayed discharge: Hospitals flag discharges that could have happened earlier because delayed discharges may exacerbate patients' exposure to hospital-acquired infections, low mood and increasing loss of functional capacity.

Discharge to the usual place of residence: We exclude maternity or "other" admission types, such as from high-security psychiatric hospitals.

Indices of multiple deprivation: We assume that Deprivation is measured using indices of multiple deprivation (IMD) for year 2010 and 2015, which measure the relative deprivation of small areas with multiple components weighted with different strengths and compiled into a single score of deprivation by the UK Ministry of Housing, Communities Local Government.

A.2 Parallel trends

In Figure A.2 and A.3, we see that the coefficient is statistically significant for length of stay after emergency admission in 2012, total cost by patient in 2013, and the number of outpatient visit in 2013. In a robustness check, we extend the pre-period to add years 2009 to 2011. The sample including the extended pre-period differs from our main sample as we only keep practices opened from 2009 to 2017. We reproduce the analysis of pre-trend and plot the associated coefficients using this sample in Figure A.7. We observe that 2013 is the only year for which the coefficient is different from zero for length of stay after emergency admission. For the number of outpatient visit, it also differs in 2009 but with no obvious trend. No time period yields a significant coefficient for total cost. However, the coefficient associated with the time period 2009 to 2011 differs from zero for the probability of emergency admission with a declining trend. This is suggestive evidence that the parallel trend assumption appears to hold in the extended pre-period, except for the probability of emergency admission.

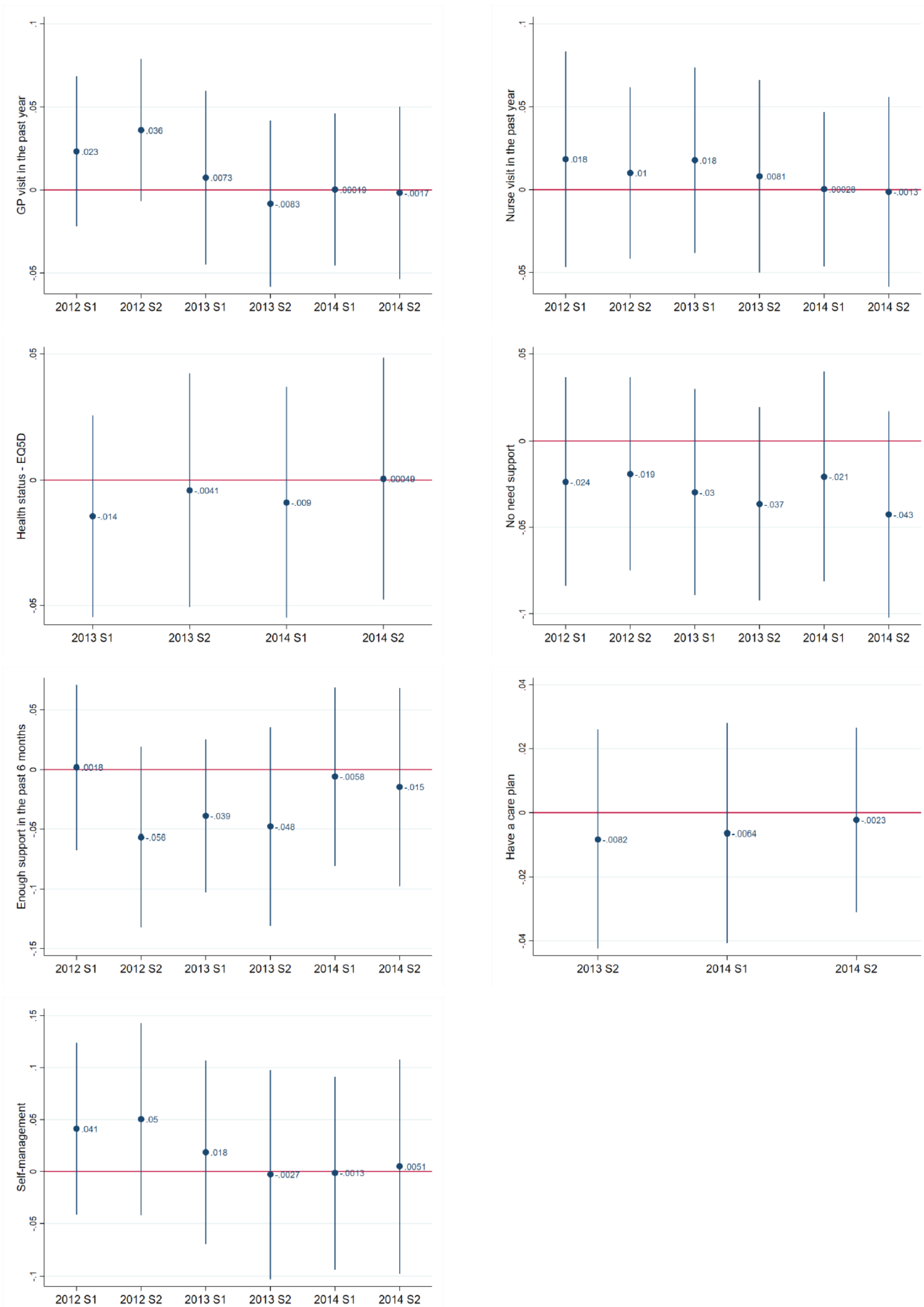
[INSERT TABLE A4 HERE] [INSERT FIGURE A2 HERE]
[INSERT FIGURE A3 HERE]

Table A.4: P-values of the joint test of pre-trend differences for each outcome

	P-value
Primary care	
GP 1 year	0.3626
Nurse 1 year	0.9933
Secondary care	
Emergency care	
Nb of emergency care attendance	0.3073
Pr. of emergency care attendance	0.1163
Nb of emergency admission	0.1980
Pr. of emergency admission	0.1493
Nb. ACSC admission	0.4123
Length of stay by emergency care admission	0.1207
Planned care	
Nb. outpatient visits	0.0680
Pr. Outpatient visit	0.1444
Nb. of elective care admission	0.1683
Pr. of elective care admission	0.2224
Length of stay by elective care admission	0.8444
Other secondary care outcomes	
90 days readmission by adm.	0.5848
Discharged in care home	0.1959
Delayed Discharged	0.2368
Total cost by patient	0.992
Health status	0.8967
Patient experience	
Self-management	0.6482
Having a care plan	0.9635
Enough support in the past 6 months	0.2990
No need of support	0.8462

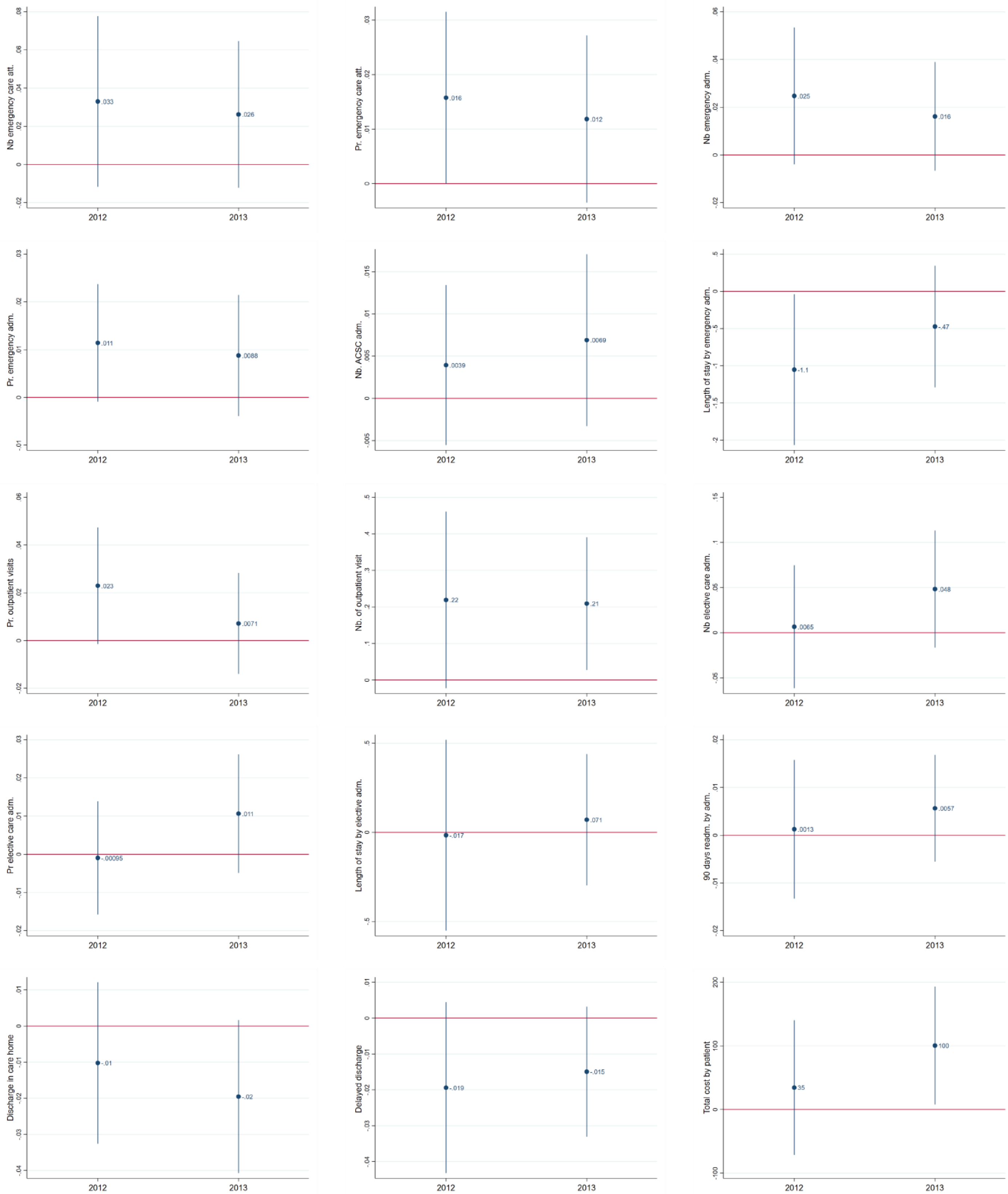
Note: Each P-value corresponds to the joint significance test of the triple interaction Salford X Year X Over 65 estimated on pre-period years. Time-varying factors are year dummy, the number of full time equivalent, the proportion of patients over 75, indices of multiple deprivation and practice size. We add segment*practice fixed effects.

Figure A.2: Pre-trend of primary care outcomes, health status and patient experience



Note: The sample is restricted to the pre-period. Each dot represents the estimated change in outcome due to being 65+ in Salford in a given year compared to the last pre-period (2015 S1). Lines represent 95% confidence intervals.

Figure A.3: Pre-trend of secondary care outcomes



Note: The sample is restricted to the pre-period. Each dot represents the estimated change in outcome due to being 65+ in Salford in a given year compared to the last pre-period (2014). Lines represent 95% confidence intervals.

A.3 Results

[INSERT TABLE A5 HERE]

Table A.5: GP practice characteristics before and after matching, averaged over pre-period

GPPS data	**Pre-period - Before matching**			**Pre-period - After matching**		
	England	Salford	P-value	England	Salford	P-value
Practice list size	7427.8	5432.4	0.000	5399.9	5385.2	0.851
	(4263.7)	(3477.0)		(3168.7)	(3370.8)	
Full time equivalent	4.702	3.190	0.000	3.191	3.186	0.923
	(3.165)	(2.355)		(2.357)	(2.317)	
Proportion over 75 yo	0.0777	0.0631	0.000	0.0609	0.0608	0.831
	(0.0298)	(0.0449)		(0.0257)	(0.0220)	
Indices of multiple deprivation	25.70	41.40	0.000	41.64	41.73	0.846
	(16.95)	(19.14)		(19.62)	(19.60)	
HES data	**Pre-period - Before matching**			**Pre-period - After matching**		
	England	Salford	P-value	England	Salford	P-value
Practice list size	7283.7	5308.9	0.000	5355.5	5372.8	0.874
	(4254.0)	(3536.3)		(3278.1)	(3523.7)	
Full time equivalent	4.682	3.117	0.000	3.128	3.139	0.877
	(3.210)	(2.364)		(2.361)	(2.375)	
Proportion over 75 yo	0.0749	0.0700	0.000	0.0590	0.0589	0.879
	(0.0313)	(0.0926)		(0.0283)	(0.0222)	
Indices of multiple deprivation	26.02	41.74	0.000	41.48	41.62	0.813
	(17.08)	(19.00)		(19.62)	(19.13)	

[INSERT FIGURE A4 HERE]

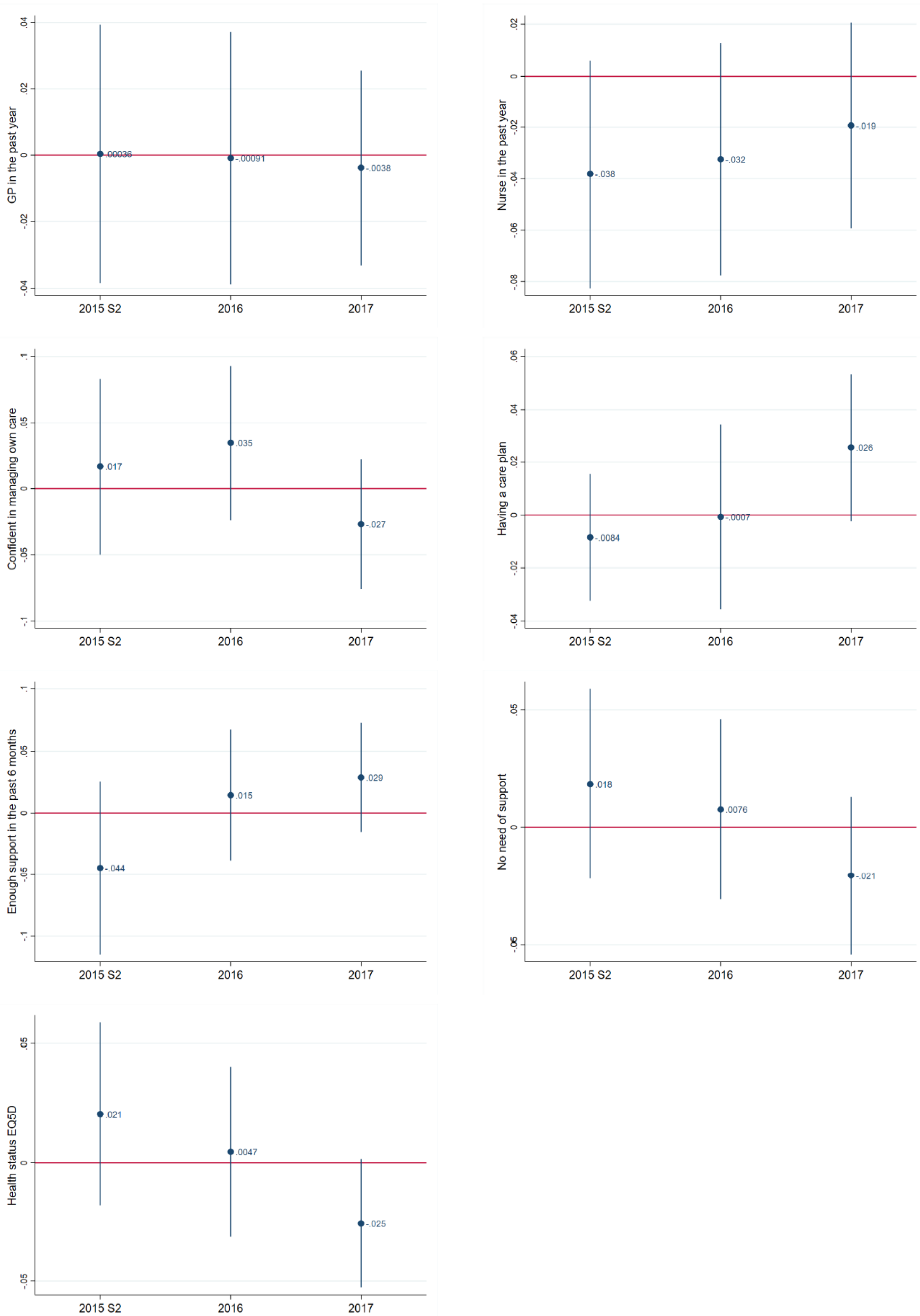
[INSERT FIGURE A5 HERE]

[INSERT FIGURE A6 HERE]

[INSERT TABLE A6 HERE]

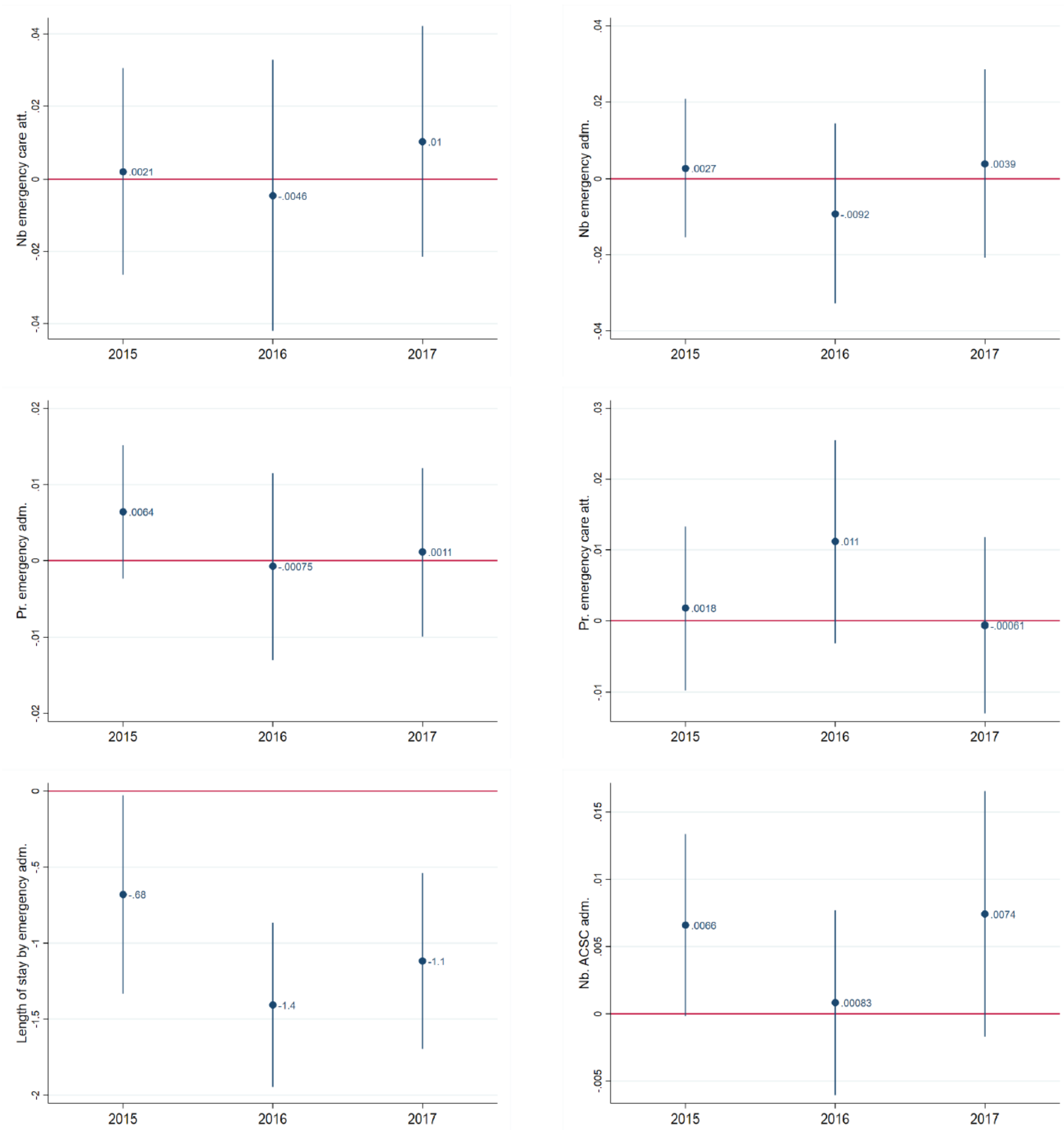
[INSERT TABLE A7 HERE]

Figure A.4: Effect on primary care use, health status and patient experience by year



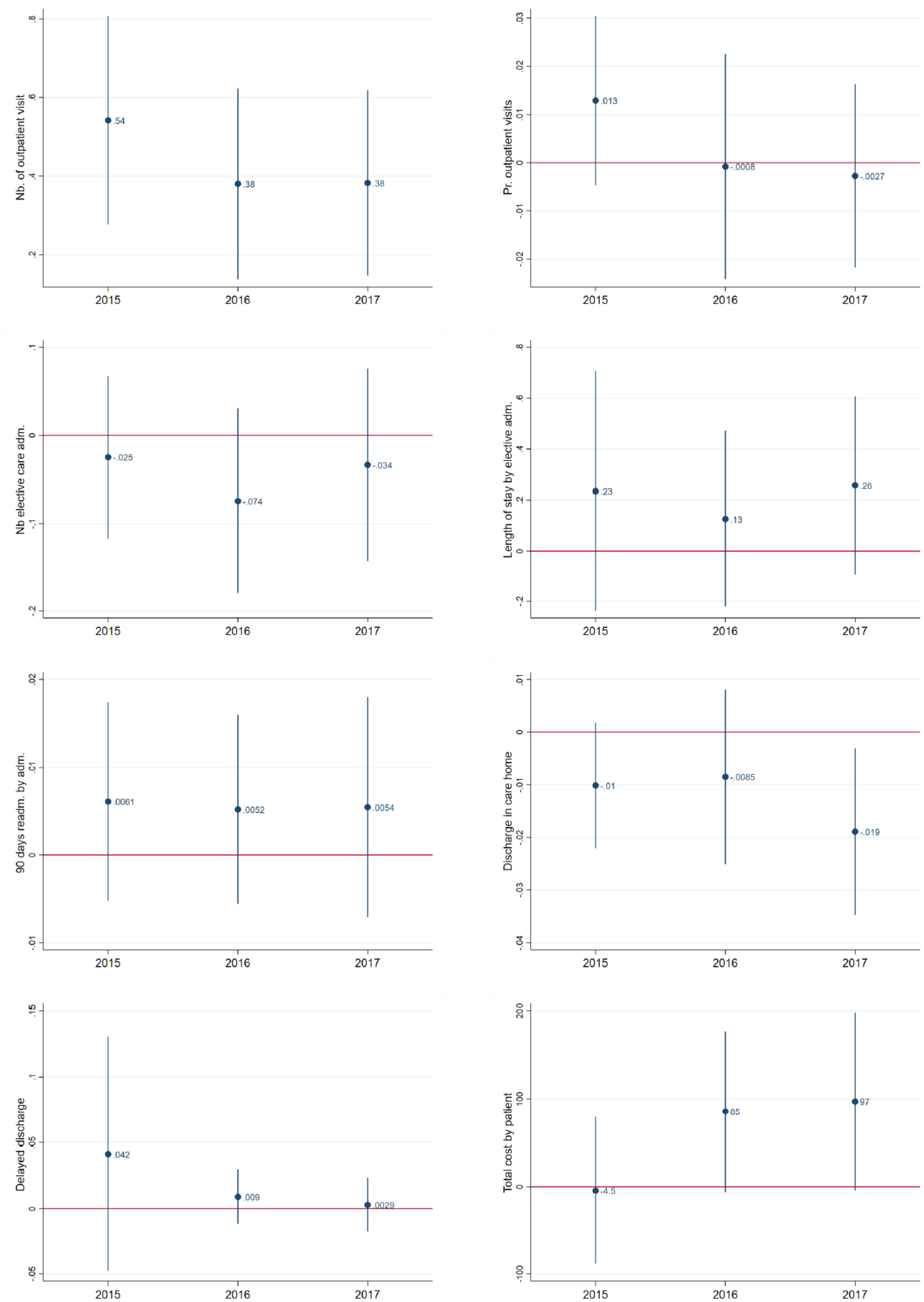
Note: Each dot represents the estimated triple difference-in-difference estimate for a given year. Lines represent 95% confidence intervals. Reference category is the pre-period.

Figure A.5: Effect on emergency care utilisation by year



Note: Each dot represents the estimated triple difference-in-difference estimate for a given year. Lines represent 95% confidence intervals. Reference category is the pre-period.

Figure A.6: Effect on planned care use and other secondary care outcomes by year



Note:Each dot represents the estimated triple difference-in-difference estimate for a given year. Lines represent 95% confidence intervals. Reference category is the pre-period.

Table A.6: Robustness checks for primary care, patient experience outcomes and health status

		Main model			Drop 2016 S1			w/o health practices			Rightcare coaching	
	Coef.	SE	Obs.	Coef.	SE	Obs.	Coef.	SE	Obs.	Coef.	SE	Obs.
Primary care												
GP 1 year	-0.001	(0.010)	421,222	-0.003	(0.011)	378,462	-0.001	(0.012)	419,713	0.007	(0.012)	27,303
Nurse 1 year	-0.030*	(0.015)	421,105	-0.031*	(0.014)	378,363	-0.024	(0.016)	419,596	-0.033*	(0.016)	27,296
Health status	-0.000	(0.011)	335,184	0.001	(0.011)	292,834	0.001	(0.013)	334,012	0.000	(0.013)	21,726
Patient experience												
No need support	0.002	(0.012)	421,370	0.006	(0.013)	378,597	0.008	(0.014)	419,860	-0.010	(0.014)	27,310
Support in 6 months	0.001	(0.017)	390,719	0.006	(0.017)	351,211	0.014	(0.021)	389,339	0.008	(0.019)	25,537
Have Care plan	0.005	(0.011)	294,531	0.007	(0.013)	252,079	0.010	(0.013)	293,517	0.000	(0.013)	19,099
Self-management	0.008	(0.015)	421,370	0.006	(0.016)	378,597	0.004	(0.017)	419,860	0.003	(0.017)	27,310

Note: Coefficients and clustered standard errors at the practice level in parentheses. $**p < 0.01, *p < 0.05$. Each coefficient is associated with the triple interaction Salford X Post X Over65. Each model includes time-varying factors (year dummy, the number of full time equivalent, the proportion of patients over 75, indices of multiple deprivation and practice size) and segment*practice fixed effects.

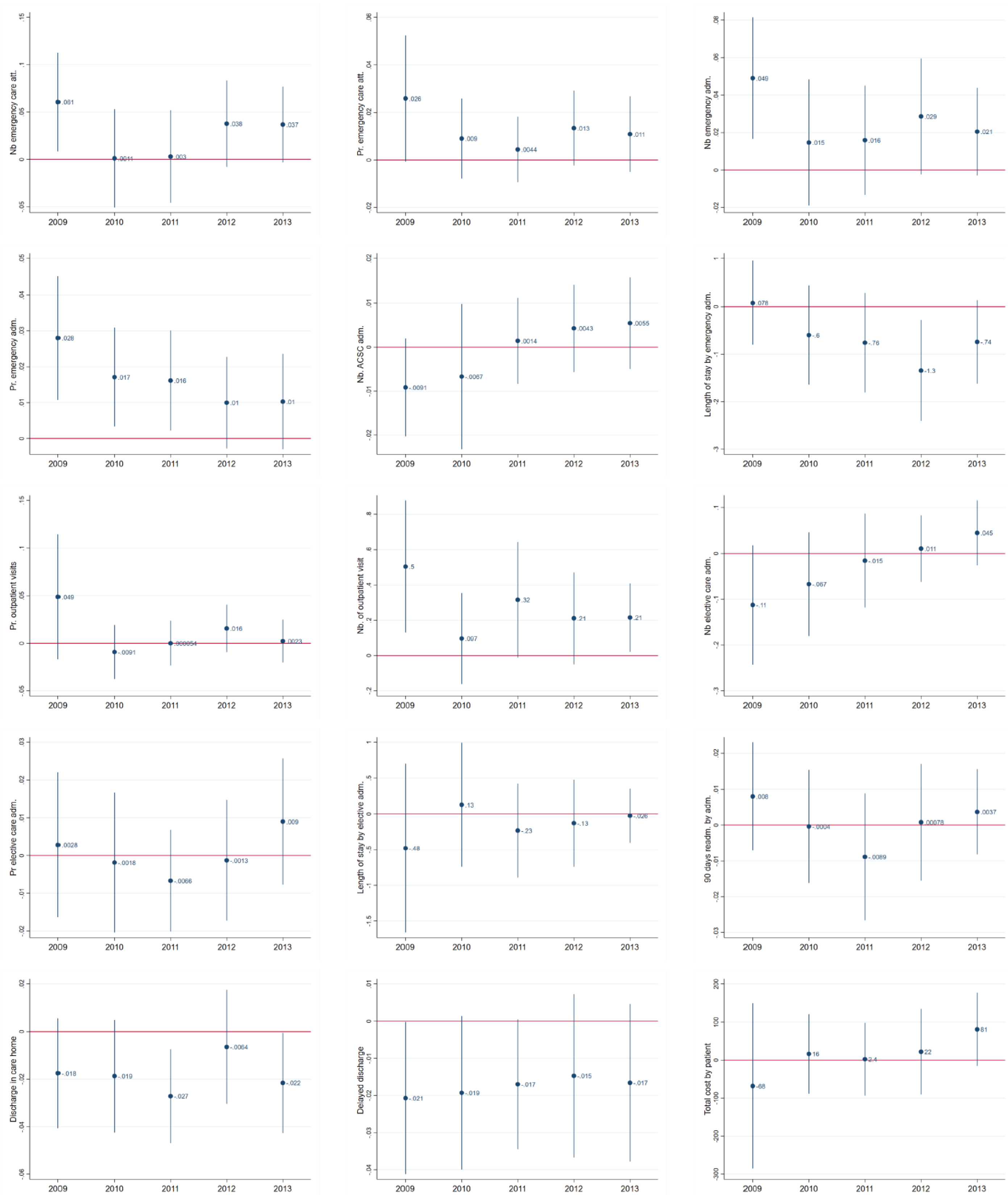
Table A.7: Robustness checks for secondary care outcomes

	Main model		Drop 2014		W/o health practices		Rightcare coaching		Extended pre-period	
Emergency care:										
Nb of emergency care att.	0.003	(0.013)	-0.007	(0.014)	0.007	(0.016)	0.005	(0.025)	0.004	(0.014)
Pr. emergency care att.	0.004	(0.005)	-0.000	(0.005)	0.006	(0.006)	0.006	(0.010)	-0.001	(0.005)
Nb of emergency adm.	-0.001	(0.009)	-0.008	(0.009)	0.001	(0.011)	0.003	(0.018)	-0.007	(0.008)
Pr. Of emergency adm.	0.002	(0.004)	-0.001	(0.005)	0.006	(0.005)	0.007	(0.008)	-0.005	(0.003)
Nb. ACSC adm.	0.005	(0.003)	0.003	(0.003)	0.005	(0.003)	0.007	(0.006)	0.008**	(0.003)
Length of stay by adm.	-1.068**	(0.240)	-0.814**	(0.284)	-1.077**	(0.290)	-1.059**	(0.267)	-1.225**	(0.235)
Planned care :										
Pr. outpatient visit	0.003	(0.008)	-0.002	(0.009)	0.008	(0.010)	0.010	(0.029)	-0.009	(0.011)
Nb. of outpatient visit	0.435**	(0.113)	0.364**	(0.120)	0.470**	(0.137)	0.528**	(0.170)	0.294**	(0.114)
Elective care adm.	-0.044	(0.049)	-0.053	(0.055)	-0.055	(0.060)	-0.041	(0.053)	0.011	(0.055)
Pr. of elective care adm.	0.022**	(0.005)	0.021**	(0.005)	0.025**	(0.006)	0.025**	(0.008)	0.025**	(0.005)
Length of stay by adm.	0.206	(0.180)	0.197	(0.141)	0.241	(0.232)	0.082	(0.202)	0.307	(0.159)
Other secondary care :										
90 days readm.	0.006	(0.005)	0.004	(0.005)	0.005	(0.006)	0.003	(0.005)	0.005	(0.004)
Discharged in care home	-0.013*	(0.005)	-0.008	(0.006)	-0.018**	(0.006)	-0.012	(0.006)	-0.008	(0.004)
Delayed discharge	0.018	(0.017)	0.024	(0.017)	0.027	(0.021)	0.016	(0.016)	0.021	(0.018)
Total cost by patient	59.300	(37.613)	36.820	(42.650)	60.882	(46.997)	99.968	(61.585)	85.062*	(39.153)
Obs.	313,392		261,160		312,864		18,720		440,640	
Nb. of segment*practices	52,232		52,232		52,144		3,120		48,960	
Nb. of practices	6529		6529		6518		390		6120	

Note: Coefficients and clustered standard errors at the practice level in parentheses. ** $p < 0.01$, * $p < 0.05$. Each coefficient is associated with the triple interaction Salford X Post X Over65. Each model includes time-varying factors (year dummy, the number of full time equivalent, the proportion of patients over 75, indices of multiple deprivation and practice size) and segment*practice fixed effects.

[INSERT FIGURE A7 HERE]

Figure A.7: Pre-trend of secondary care outcomes with an extended pre-period (2009-2014)



Note: The sample is restricted to the pre-period. Each dot represents the estimated change in outcome due to being 65+ in Salford in a given year compared to the last pre-period (2014). Lines represent 95% confidence intervals.