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Abstract
In publicly funded health care systems policy-makers face a dilemma: placing low acuity emergency care services outside hospitals may widen access to care and divert patients from making costly hospital visits, but may also attract new patients that have little need for medical care. Using detailed information contained in hospital records, I evaluate the impacts of one type of low acuity service - Walk in Centres (WiCs) in the English National Health Service (NHS) - relying on timing differences in the deployment of a single wave of services and restricting attention to places where new facilities opened to mitigate endogeneity concerns. Results indicate that WiCs have significantly reduced attendances at hospital Emergency Departments in places close by, but suggest that only between 10-20% of patients seen at hospital-based WiCs and between 5-10% patients seen at other WiCs were diverted from the more costly high acuity facilities at hospitals.

Keywords: Emergency care, primary care, Walk in Centres
JEL Classifications: R53; I11; C23

1 Introduction

Each year medical emergencies result in more than 20 million visits to National Health Service (NHS) urgent and emergency health care facilities, with just under three quarters of these taking place at Emergency Departments (EDs) at hospitals.[1] A recent policy review (NHS England 2013) signals the continuing intention to offer more urgent care services in primary care settings outside of hospitals, a move partly motivated to widen access to services but also in the hope of diverting patients away from EDs. This may be desirable because crowding at EDs is associated with high mortality and reduces capacity for hospitals to carry out planned health care treatments, because emergency care in high acuity settings is more expensive, and because only around a quarter of ED attendees are admitted with a further quarter receiving no kind of treatment at all (Figure 1).

However, there is a risk that such policies could have unintended effects. Individuals who suffer adverse health can not usually evaluate the level of treatment they need, and in the NHS where services are free at the point of service face few incentives to limit their use of services. While NHS GPs act as gatekeepers to ration access to planned secondary care services, no such mechanism exists to limit visits to urgent care services. Policy-makers facing tight budgets therefore face a dilemma: by increasing the number and range of services outside of hospitals they may widen access to care and divert patients from making costly hospital visits, but may also attract new patients that have little need for medical care, potentially leading to excessive use of services and spiraling costs.

This paper provides evidence about the possible impacts of such policies by evaluating the extent to which one kind of urgent primary care facility — Walk In Centres (WiCs) — impact on ED outcomes in the context of the English NHS. Some 230 WiCs were opened in England in the last decade aiming to provide easily-accessible primary care by offering patients routine or emergency treatment from a GP or nurse without the need to make an appointment. The centres, which usually operate extended hours and open at the weekend and on public holidays, are equipped to deal with all but the most serious cases such as major trauma, heart attacks or strokes which can only be dealt with at hospitals. Despite proving popular with patients, many centres have recently closed or are due to close, at least in some cases because administrators

[1] These are Consultant led 24 hour services with full resuscitation facilities and designated accommodation for the reception of accident and emergency patients. I use this terminology throughout since the term "Accident and Emergency" is commonly used to describe EDs at hospitals but is also often used as a catch-all term to describe any kind of emergency care facility.

are sceptical they have reduced pressure on other NHS services.

Portraying the opening and closing of WiCs as a change in the local supply of emergency care illustrates that the overall effect of the supply shift will depend on the shape of the demand for such services. With downward sloping demand, new WiCs make accessing emergency care cheaper for some patients and may attract new patients that otherwise would not have sought any emergency treatment. With inelastic demand, the overall number of patients using emergency health services is fixed so every WiC attendance should represent a one-for-one diversion of patients away from a hospital ED. Since the shape of the local demand for emergency care services is unknown, the extent to which WiCs have diverted patients from EDs appears a legitimate empirical question.

Two main problems hamper the ability to find correlations between the availability of WiCs and attendances at nearby EDs and to make a causal interpretation. The first is that proximity to centres from any given location is the result of a series of decisions about emergency service configuration made by health administrators, for example whether to open a new centre and where it should be located. Although it is possible to gain some insight into how these decisions are taken, in general the decision making process is a black box and the suspicion must be that the local availability of walk in services may well be correlated with unobserved underlying drivers of ED attends which cannot be controlled for. In other words WiCs may be targeted towards places that are experiencing increasing ED attendances (or factors that will cause increasing ED attendances in the future) with any observed correlation reflecting this phenomenon.

To mitigate this, I exploit staggered variation in the local availability and accessibility of walk in centres for potential users of these services across space, basing estimates on changes in ED outcomes in small geographical areas close to walk in centres when a centre opens or closes. This specification is designed to address concerns around the endogenous location of WiCs by ensuring the control group for these changes is provided by other areas that are suitable and feasible locations for WiCs, but which do not experience any changes in the availability of walk in services at that particular time. In my main models, I push this strategy further by relying exclusively on a single wave of WiCs that opened under a policy program that imposed certain criteria for the location and specification of roughly 150 new centres, exploiting timing differences in openings driven by administrative constraints on the deployment of the new services to estimate effects.

A separate, albeit related, set of problems arises because the effects of WiCs are likely to be conditional on where they are located — both in relation to existing population clusters and other similar services — but how spatial effects manifest is *a priori* unknown. This is further complicated by urban density issues that may see patients travelling further to use emergency services in places where other health services are more scarce. To address these issues, I use a spatial strategy to create a treatment intensity measure that is a non-parametric function of distance to walk in services. Counts of open WiCs in distance buffers centred on particular locations provides variation in treatment intensity which is then compared to changes in localised use of EDs. Distance buffers are constructed in a way that allows them to vary across space based on the observed travel distances that patients undertake to access emergency health care locally.

Contrary to previous empirical research that could not discern an effect (Ferber and Becker 1983; Salisbury et al. 2002), when adopting these methods I find that WiCs significantly reduce overall volumes of attendances at Emergency Departments. In line with intuition, effects appear to be sharper for patients who live in close proximity to the centres, for WiCs co-located with EDs, and for WiCs in places with fewer substitute services available. These effects appear to be driven by diverting patients who are recorded as having made the decision about where to attend on their own, having neither been referred by a GP nor conveyed in an ambulance. Taking account of WiC opening hours I estimate that between 10-20% of patients seen at hospital-based WiCs and between 5-10% patients seen at other WiCs were diverted from more expensive high acuity facilities at hospital EDs. These estimates are below the diversion rates suggested in surveys where typically around a quarter of patients state that in the absence of the walk in centre they would have attended an ED (Rizos et al. 1990; Accent 2013).

2 Walk In Centres: description and literature

2.1 Institutional Background

The National Health Service (NHS) in England and Wales provides health care services free at the point of service. It is estimated to be the fifth largest employer in the world and with an annual budget of roughly £100 billion, represents around 15% of public spending in England and Wales. In stylized terms, the traditional model for NHS services comprised specialist care in a hospital setting alongside GP services inside and outside normal hours for more routine health care needs. High severity emergency cases were treated in hospital Accident and Emergency (A&E) Departments including both Consultant led 24 hour services with full resuscitation facilities catering for all kinds of emergency (Type 1 units or Emergency Departments (EDs)) as well as a small number of Consultant led single specialty services such as eye and dental hospitals (Type 2 units). Patients with less severe unplanned health care needs could access primary care services from their registered GP by making an appointment (including emergency appointments), or outside normal hours by using a GP Out of Hours (OOH) service.

Since the mid 1990s, policy-makers have introduced several new kinds of additional emergency and urgent care services specifically designed to meet the needs of patients with minor injuries or illnesses. The intention to provide emergency services outside hospitals remains and was reiterated in a recent review into the urgent and emergency care system led by the National Medical Director (NHS England 2013). New services introduced to date include a telephone advice service — NHS 111, formerly NHS Direct — and a range of NHS facilities offering patients face to face advice and treatment for low severity emergences from a GP or nurse without the need to register locally or make an appointment. Known as Type 3 units, they include NHS Walk in Centres (WiCs), Urgent Care Centres (UCCs) and Minor Injury Units (MIUs).[2] Most were located outside of hospitals, although some were positioned within hospitals directly next to EDs. In some cases when a patient enters the hospital for emergency treatment, she is met at the front door and directed to the emergency service most appropriate to the presenting condition, a process known as triage.

NHS Walk in Centres provide routine and emergency primary care for minor ailments and injuries with no requirement for patients to pre-book an appointment or to be registered at the centre (Monitor 2014). Around 230 centres were opened in England in three waves in the period 2000-2010 (Figure 2). Roughly 70 nurse-led walk in centres (i.e. only staffed by nurses with no doctors present) opened in the period 1999-2004, including 20 pilot sites opened before December 2001 and a group of facilities established at hospitals alongside pre-existing EDs in 2004. A second wave of WiCs saw 6 Independent Sector GP led centres designed to cater for the needs of commuters opened at train stations in major cities in the period 2005-2007. More recently, around 150 new centres — often referred to as GP-led health centres or Darzi centres — were commissioned as part of a third wave of WiCs following a policy initiative prompted by

[2]Little data is available for the latter two types of unit, and in some cases they are difficult to distinguish from WiCs. See Monitor (2014) for a review. In the remainder of this study I focus chiefly on WiCs.

an interim report in October 2007 by then Parliamentary Under-Secretary of State for Health, Ara Darzi (Darzi 2007). The advent of this third wave of centres led the number of open centres to peak in early to mid 2010 but since then, as many as 40 centres have closed with a strong possibility that more will follow.

The third wave of centres forms the basis of much of the empirical work that follows. Following the 2007 Darzi report, the Department of Health set up a new policy known as Equitable Access to Primary Care (EAPC). The twin aims of the policy were to improve access to primary care in the most under-doctored areas of the country, and to deliver more personalised and responsive care across England. To this end Ministers announced £250 million of new annual funding to support the establishment of 100 new GP practices in the 38 Primary Care Trusts (PCTs) with the lowest per capita GP provision, and additionally required each of the 152 PCTs to establish one new GP-led health centre. The new services were to be commissioned through competitive procurements. The policy background provides grounds to suggest these centres should form a relatively homogeneous group both in terms of the specification of services as well as the characteristics of the locations where they were sited. The centres had to offer a regular registered GP practice service as well as walk-in services for any member of the public from 8am until 8pm, 7 days a week, 365 days a year. Core criteria set out in policy documents also required them to be located in areas that maximised convenient access to services and opportunities to colocate and integrate with other local services (Department of Health 2007).

As a result of the policy initiative, almost all PCTs commissioned at least one wave three WiC from a GP-led consortia, a private sector provider, or a third sector enterprise. Opening dates were for the most part restricted to a fairly narrow window with the first centre, the Hillside Bridge Healthcare Centre in Bradford, opening in December 2008, roughly a third opening before the end of April 2009, more than two thirds by the end of 2009, and all but two by the end of 2010. The timing of contract award and opening of the new centres across PCTs is an important part of my identification strategy. Guidance issued by the Department of Health (Department of Health 2007) highlights the pressure from the centre on PCTs to commission these services quickly with an expectation that all procurements should be finished in 2008/9. It strongly suggests the main factors driving the timetable for the new centres were administrative — readiness on the part of the PCTs to specify the new services and identify suitable premises, the speed of the procurement process, and the time needed to prepare the new site. Although PCTs were free to set contract lengths, centres were typically but not exclusively commissioned on five year contracts. Combined with the length of contract awarded, the contract award date serves to determine the contract end date. At this point, PCTs had the option to decommission these services i.e. to close the service or to award a new contract. Some commentators have suggested that closure decisions were driven by the initial contract value awarded, which in some cases implied a cost per patient far above most traditional GP practices.

2.2 Walk in Centres and Emergency Departments

The objectives of WiCs are often couched in terms of widening access to health care services (NHS Executive 1999; Darzi 2008), but a further rationale is that many patients attending EDs might be treated more efficiently in lower acuity facilities outside hospitals.[3] Hospital records show that only around a quarter of ED attendances result in an admission and a further quarter of attendances result in no kind of treatment at all (Figure 1). Although difficult to evaluate precisely, it is estimated that around 15-30% of patients attending EDs in the NHS could be treated safely in primary care settings.[4] Given the lowest administered price for an ED treatment (a urine test) is higher than the highest tariff for *any* activity performed at a walk-in clinic (House of Commons Health Committee 2013, Evidence p. 32), diverting anywhere near this proportion of patients to low acuity emergency units would likely generate considerable savings to the NHS.

Beyond efficiency concerns, there are other reasons why administrators may wish to divert patients with low severity emergency health needs from EDs to WiCs and other low acuity facilities. Crowding at EDs can reduce the quality of care at EDs and is associated with increased mortality and an increased number of serious incidents (College of Emergency Medicine 2014). Spikes in attendances at EDs — particularly common during winters — can further compound this congestion. Crowding can also leave patients dissatisfied and jeopardise the fulfillment of highly politicised nationally set waiting time targets. Finally, high volumes of admissions through EDs can also have knock-on effects on planned care by taking up beds, forcing the cancellation of planned operations, and in extreme cases even causing hospitals to shut down

[3] See for example the evidence of John Appleby, Chief Economist of the King's Fund, to the Health Committee "Until 2003/4, statistics on A&E attendances included major A&E units only. But around this time more, smaller units including walk-in centres and minor injuries units were introduced with the intention of diverting less serious emergency cases away from the larger, more expensive A&E departments" (House of Commons Health Committee 2013, p. 11).

[4] "Millions should not be in A&E", Sky News interview with Professor Keith Willett, national director for Acute Episodes of Care, 7 September 2013. http://news.sky.com/story/1138301/millions-should-not-be-in-a-and-e-exclusive

whole parts of elective services(Health Service Journal 2013; Royal College of Surgeons 2013).

For these reasons, and especially when finances are tight, policy-makers may be concerned to understand the extent to which WiCs (and other Type 3 units) divert patients away from EDs.[5] There is little systematic data on activity at individual WiCs, but surveys suggest that they have proved popular, especially for the young, women, and lower social groups, with between 12 and 60 thousand patients attending each centre each year (Monitor 2014). Anecdotally it appears that many new centres were initially oversubscribed and had to expand capacity or close at certain times to cope with unanticipated levels of demand. Figure 3 shows trends in attendances at Accident and Emergency Departments by Type weighted by population since 2004/5, a period roughly coinciding with the growth in WiCs. The dark grey line shows an upward trend in attendances at Type 3 units in the period and is consistent with aggregate growth in WiC activity. The figure also shows that attendances at Type 1 and 2 emergency units (light blue line and light grey line) have remained fairly flat throughout the period so that overall A&E attendances (dark blue line) have risen in step with Type 3 growth.

Basing inferences on the aggregate trends in A&E attendances depicted in Figure 3 is tricky since these trends could plausibly result from different underlying market equilibria that are observationally equivalent in what effectively amounts to a demand/supply identification issue. The top left part of Figure 4 illustrates that with inelastic but exogenously shifting demand for emergency care, an outward shift in emergency care supply brought about by new WiCs brings emergency care closer to some patients and reduces the time and money costs of patient attendances from P0 to P1. Because demand is fixed at the level of the vertical demand curve, WiC activity directly substitutes for ED activity and every attendance at a WiC means one less attendance at an ED. Under such conditions, the aggregate trends in Figure 3 might be explained by an unrelated exogenous outward shift in demand that might result from - say - an aging population or increased patient expectations, as shown in the top right part of the figure.

On the other hand, the bottom panel in the Figure illustrates with elastic but fixed demand for emergency services, by reducing the costs for patients to access emergency care services the opening of new WiCs may have attracted new patients that otherwise would not have sought emergency care. Here, the local supply shift in emergency care results in a move along the demand curve. Some policy-makers have likened this to the 'fundamental law of congestion'

[5]A related question is whether access to GP services drives ED outcomes. See for example Cowling et al. (2013) for recent evidence.

(Duranton and Turner 2011) where opening more roads can create more traffic.[6] Building on this interpretation, others have argued that meeting this demand, unmet at the previously prevailing prices, may actually be of low priority to the NHS (despite the value to consumers of these services implied by their use) . This might be the case if the newly satisfied demand is of low clinical value (the "worried well") or if much of the induced demand is actually patients seeking a second opinion to other advice received, for example from a GP, rather than representing any widening of access.

In practice it is clear that WiCs, or other Type 3 units, will not always provide a perfect substitute for attendances at hospital emergency facilities, not least because they are not open at all times like EDs, and because they are unequipped to deal with the most serious cases such as major trauma, heart attacks or strokes. Additionally, patients are not always responsible for the choice of location of their emergency attendance. Certainly, patients conveyed to emergency facilities in ambulances have little input into the destination of their journey. In many other cases, patients are referred to emergency facilities (e.g. a GP) and although there is no obligation to comply it seems unlikely that many patients will ignore such a recommendation. Even when they are able to make an active choice, incomplete information may mean patients attend EDs even when a WiC provide the same service at a lower price, either because patients are unable to assess the level of severity of their condition (Jackson et al. 2005) and are risk averse, or because of incomplete information about the availability of services. This is consistent with suggestions that patients confused with the array of emergency services may 'default' to EDs (NHS England 2013).

2.3 Related Empirical Literature

A small body of policy and academic literature has attempted to evaluate the extent to which WiCs divert patients from EDs. Perhaps the most common approach has been to survey patients attending centres. While exact figures vary, such surveys typically find that around a quarter of patients state that in the absence of the walk in centre they would have attended an ED, a third would have attended a GP, and a tenth would have self treated (Rizos et al. 1990; Accent 2013). A second strand of research has sought to evaluate the impact of particular new Type 3 services using data on the activity levels of nearby providers or by following patients through the health care system. By their nature findings from such case studies are difficult to generalise

[6] http://www.gponline.com/gp-contract-not-blame-a-e-pressure-nhs-leaders-say/article/1183473

but provide useful contextual information. For example, Heaney and Paxton (1997) finds that in the the three months following the opening of a new MIU, the local ED experienced a 24% drop in attendances. More recently Simon et al. (2012) finds that two Freestanding Emergency Departments significantly reduced volume and admission rates for the main ED while increasing the volume of emergency attendances for the local health care system as a whole.

A handful of studies provide a more general evaluation of the impacts of WiCs on other health care services by systematically examining activity levels at neighbouring providers. One widely cited early large scale US study (Ferber and Becker 1983) examined a large sample of walk in centres, finding no impact on nearby EDs over 10 years when compared to a control group. As part of a national evaluation of 39 first wave walk in centres developed up to May 2001 Salisbury et al. (2002) examined before and after changes in activity at a randomly selected ED and eight randomly selected GP practices close to the WiC, finding no statistically significant impacts when compared to subjectively matched control sites. However, such studies either do not convincingly control for the endogenous availability of walk in services, or impose strict or arbitrary assumptions about the spatial impacts of WiCs. In the rest of this paper, I aim to provide quasi-experimental empirical evidence that attempts to circumvent these problems.

3 Data

3.1 Walk In Centres

To undertake the following empirical work a database containing information on the full population of all 228 Walk in Centres in England was created from information contained in a recent report issued by Monitor, a Non-Departmental Public Body responsible for regulating the hospital sector in England. This report provided a list of open and closed walk in centres as at early 2014 along with an address including full postcode for each site. WiC opening and closing dates were then matched into this data using datasets available from the Organisation Data Service (ODS) provided by the Health and Social Care Information Centre (HSCIC). Basic checks revealed that given information was often inaccurate, so dates were individually verified by desk research (e.g. by checking websites for the organisation itself, contemporary press reports, and policy documents available online).

With no single recognised definition of a walk in service and no central database, determining additional pieces of information about individual WiCs — opening hours, numbers of medical practitioners, details of contracts etc — proved challenging. The full postcode was used to geocode the location of each centre using the postcode centroid given in the 2013 Postcode Directory available from the Office of National Statistics. By spatially matching information about the location of hospitals, WiCs were then grouped into those co-located with EDs and those located away from EDs. Further desk based research also enabled classification of facilities into groups corresponding to three waves of walk in centres commissioned under different policy initiatives referred to above. This is potentially helpful because some policy initiatives set out criteria for the specification of the new services, so that these WiCs might reasonably be expected to share some common characteristics.

Figure 2 shows the overall count of open centres for each quarter in the period 1999-2014, illustrating the sharp increase in WiCs in 2008-2010 and the subsequent decline as more centres began to close. Figure 5 shows the distribution of open and closed WiCs as at 1 December 2002 (LHS), at 1 September 2008 (centre), and at 1 January 2012 (RHS). These maps illustrate that the earliest centres were mainly clustered in the North West and London with subsequent centres opening in the North East and the Midlands. The third wave of WiCs then brought centres to a much wider range of locations, including to outside the main urban areas in England. Table 1 reports counts of WiCs by type, classifying each centre according to whether it is co-located with an ED at a hospital, whether it is led by GPs or nurses, and the wave under which the centre was commissioned.

3.2 Accident and Emergency

Accident and Emergency data is drawn from two main sources: the Quarterly Monitoring of Accident and Emergency (QMAE) dataset published by NHS England, and Hospital Episode Statistics (HES) records provided by HSCIC.

QMAE is the official source of information on A&E activity. It is generally considered to be the most comprehensive and reliable source of aggregate information on emergency activity and is used to check compliance with waiting times targets. QMAE holds quarterly counts of total emergency attendances at NHS and non-NHS providers, and the breakdown of attendances at Type 1 units and other units (Figure 3).[7] QMAE data is recorded at the provider, rather

[7] The other category includes Type 2 and Type 3 attendances, no split is available. Unit Types can be distinguished in this data from 2003/4 which sets the lower bound on the time-frame of my analysis.

than the site, level. For most providers this is inconsequential since there is only one site, but some NHS Trusts have multiple emergency care sites (which may be a mix of Type 1, 2 & 3 units) so where this is the case the split of attendances across sites can not usually be observed. Nevertheless, a panel of Type 1 attendances for NHS Trusts can be constructed for the period 2004q2 to 2011q3. A number of NHS Trust mergers have taken place in this time; to account for this I group together earlier data for NHS Trusts which will eventually merge in order to create a balanced panel of 146 NHS Trusts over this period.

The second data source, the HES A&E dataset, comprises detailed records of individual attendances at emergency care units, including the patient's residential location (Lower Super Output Area (LSOA)), the patient's registered GP practice, the type of unit (Type 1, Type 2, Type 3), and the time of the attendance.[8] It is also possible to identify how patients ended up at the facility, e.g whether they were conveyed in an ambulance or referred by a GP, and what happened to the patient at the facility e.g. whether they received treatment and/or were admitted. While the HES A&E dataset constitutes a rich source of information, it is apparent that not all providers submit data, and for those that do some data fields are not reliably coded.[9] Figure 7 highlights the coverage issue by contrasting total attendance counts for England for quarters in the period 2008q2 to 2012q2 in the two data sources. HES coverage begins at around 70% of the QMAE total and climbs by roughly 10% over the period. Closer inspection reveals that coverage of attendances at NHS Trusts is very high and broadly stable, while coverage of attendances at providers other than NHS Trusts — including Primary Care Trust (PCTs), community hospitals, and WiCs — is very low. Crucially, almost all WiCs do not provide data to the HES dataset, effectively making it impossible to analyse WiC activity changes using the HES data and imposing an important constraint on this research.

As EDs are exclusively run by NHS Trusts, I focus on activity at Type 1 units to mitigate this problem. Even then, data issues can not be entirely avoided because the field indicating the unit type in HES was only introduced in 2008/9, with less than 50% of records in this first year of data having a valid code recorded. While by 2011/12 more than 95% of fields are coded with a valid code, it is not possible to determine whether increases in Type 1 attends at a given provider will represent genuine attendance growth or simply more complete recording of

[8]LSOAs are an administrative geography built up from Output Areas. There are 32,844 LSOAs in England with a mean population of 1,630.

[9]This reflects that HES A&E data was until 2012/13 published as experimental statistics. According to HSCIC, it remains a developing data set which has a number of continuing issues regarding quality and coverage of certain key fields.

activity. I address these problem in two ways: first, I drop quarter-location cells that have fewer than 50 attendances.[10] Second, I clean the the HES Type field based on the QMAE data which tells me which provider by quarter cells should only contain Type 1 attends and which should contain only non-type 1 attends. Using this information I assign type to 6.2 million attends where the type field is uncoded, denoting this the 'cleaned' HES data.[11] Figure 6 shows the extent to which these operations reduce the number of uncoded cells in the data. Because a large proportion of attends in financial year 2008/9 remain uncoded even after cleaning, I then additionally drop attends in these quarters.

Once the data has been cleaned, I remove duplicates and create several ED outcome variables for quarter-LSOA cells using fields relating to the method of arrival, the time of arrival, and the care received as part of the visit. I also combine this with demographic data for LSOAs published by the Office for National Statistics (ONS), interpolating mid-year estimates of population by age group to the quarterly level.

4 Empirical Approach

4.1 General Spatial Approach

My data constitutes quarterly series of ED outcomes at the NHS Trust and the LSOA administrative geography and a database of WiCs including opening and closing dates. In this section, I describe the approach I take to combine these data and my attempts to formulate a research design intended to permit a causal interpretation of resulting estimates. My general approach amounts to a fixed effect panel research design that compares changes in ED outcomes to changes in the local availability of WiCs, taking the general form:

$$\ln \text{ ED}_{it} = \beta \cdot \text{WiC TREATMENT}_{it} + x'_{it} \cdot \gamma + f(i,t) + \epsilon_{it} \tag{1}$$

Where the dependent variable is the log count of ED attendances or admissions in quarter t, the

[10]This effectively drops a large part of my sample. My expectation is that this should help me to address data quality issues rather than pick up effects unique to larger spatial units. I adopt alternative specifications that entail no drops to provide reassurance on this point.

[11]To check robustness, in a second step I additionally reassign type for cells that do have a type given, but where it is inconsistent with the QMAE data for that provider in that quarter. I denote the result of this second step the 'reassigned' HES data. When type implied by the data sources clash, it is uncertain where the mistake lies, so my main estimates remain based on the cleaned data.

principal variable of interest is WiC treatment — a measure of walk in centre accessibility that relies on spatial proximity described further below, x is a vector of time varying controls, and f(i,t) are fixed effects which allow for unobserved time and place variation. I run various versions of this model distinguishable by the cross sectional identifier (and geographical fixed effect) i and the dependent variable. To illustrate how this plays out in practice, consider the effect of a newly opened WiC in a town. With the QMAE data, I can examine the effect of the WiC on the number of people attending the local ED in the town (the i's are spatially proximate EDs). With the HES data I can explore the effect of the newly opened WiC on attendances at EDs but restricting attention to people living in close proximity to the WiC (the i's are spatially proximate LSOAs), providing a more precise analysis of spatial effects of the new centres.

To specify WiC treatment, I design a treatment intensity measure based on the counts of WiCs open and accessible from a given location: (WiCs_open, WiCs_accessible). I have little data on the levels of service at individual WiCs (e.g. opening hours, numbers of medical practitioners) so define WiCs_open as the count of WiCs that were open in the previous period (t-1) and that are not closed in the current period (t). I use such an approach because new WiCs may take some time to bed down, and because in a small number of cases I may have the contract award date rather than open date. In any case, exact timing is not critical since estimation is based on a time-demeaned approach that effectively compares some kind of average outcome across periods before and after WiC changes (Gibbons 2014).

Because the spatial scale of impacts of WiCs is uncertain and with no exogenous restriction of who can use WiCs, I rely on a spatial strategy that counts the number of WiCs within distance buffers centred on the cross sectional identifier to define WiCs_accessible. These buffers allow me to construct treatment intensity as a non-parametric function of distance to WiCs (Gibbons et al. 2011; Faggio 2014). In the aggregate model they are centred on the spatial co-ordinates of each ED (since I can not observe patients' locations with this data) and in the local models the centroid of each LSOA. It seems likely that the spatial bounds of WiC impacts will differ in urban and rural places, for example according to the availability of alternative types of health care (such as EDs and GPs). To allow for this, I adopt distance buffers that vary across space according to estimates of typical distances travelled to access emergency care in each location. These buffers vary at the Travel to Work Area (TTWA) level and are generated from the distribution of distances patients travel to attend emergency health care facilities.[12]

[12]These are based on distances patients travel to attend EDs in the HES data 2008/9 to 2012/13. This is driven by practical considerations (WiC attendances are not recorded in HES) but the use of ED visits should ameliorate

Specifically, I define three distance bands based on typical travel distances in the TTWA: the lower quartile distance travelled (p25), the median (p50), and the upper quartile (p75), constructing buffers in a discrete way such that each WiC falls into only one distance band for each unit of observation. To allow for different effects for WiCs co-located at EDs, I create a separate treatment for all WiCs at EDs within the median distance travelled i.e. within the first two buffers. This gives me four buffers in total, and the following estimated equation:

$$\ln \text{ ED}_{it} = \beta_1 \; WiCs_{it}^{p25} + \beta_2 \; WiCs_{it}^{p50} + \beta_3 \; WiCs_{it}^{p75} + \beta_4 \; WiCs_{it}^{ED} + x_{it}'\gamma \; + f(i,t) + \epsilon_{it} \quad (2)$$

This set up is designed to partial out unobserved spatial and time varying heterogeneity f(i,t). By including cross-sectional fixed effects I remove any fixed factors at the level of the provider (aggregate model) or LSOA (local models). These partial out many potential time-invariant effects and should be particularly powerful at the local level in terms of dealing with relatively slow-changing or fixed characteristics of small areas such as the structure of the local health economy. Second, by including quarterly dummies I eliminate any common time effects such as general trends towards greater emergency care usage, national policy changes, as well as seasonal patterns in health care need and nation-wide peaks in health care need such as might occur with the outbreaks of viruses. To control for additional time varying unobservables I also include separate year dummies for WiCs in each distance band and for ED WiCs.

In some specifications I include three further groups of control variables. Quarter dummies interacted with Government Office Region dummies account for any regional trends, soaking up a wide range of unobserved effects that have the potential to bias results. Second, in LSOA models I include counts of LSOA population in five age bands (aged less than 10, aged 10-19, aged 20-49, aged 50-69, aged 70+). These controls, interpolated from annual estimates, take account of overall changes in LSOA populations as well as demographic changes which could be important determinants of health care need. Finally, in some LSOA specifications (chiefly where I examine ED outcomes during the hours that WiCs are open), I also include the (log) LSOA attendance or admission rate per 1,000 population for activity taking place in hours when

concerns about the endogeneity of resulting buffers. I approximate patient starting location as registered GP practice and attendance location as the closest ED (relevant where an NHS Trust has more than one ED); I remove extreme journey lengths which I define as the top 5% longest trips and irregular trips which I define as ones where fewer than 100 attendees from a specific GP visit the ED during the entire period. I also create buffers that vary at the LA and PCT level and report results in robustness checks along with results for buffers based on fixed distances based on averages from the raw data. In all but the last case results are materially unchanged. More details in the Appendix.

WiCs are closed, account for potential unobserved trends that are affecting ED outcomes both during the day and night at the LSOA level.

4.2 Endogenous Placement of Centres

A key methodological challenge, common to almost any policy evaluation, is that non-random incidence of policy treatment creates difficulties in determining would have happened in the absence of an intervention.[13] Proximity to WiCs from any given location is the result of a series of decisions made by health administrators, for example where and when to open a new centre or whether to close an existing one. While it is possible to gain some insight into how such decisions are taken, in general this is a black box and the suspicion must be that the local availability of services may be correlated with unobserved underlying drivers of ED outcomes which cannot be controlled for. In this context, it might be reasonable to expect that WiCs are targeted towards places that are experiencing increasing ED attendances or admissions, to places that are expected to have increasing ED attendances or admissions in the future, or places that have factors that are correlated with these phenomena. As such any association between WiC availability and ED outcomes would likely be biased towards finding that WiCs are associated with worsening ED outcomes, for example more ill health, more ED attendances, or more ED admissions.

Specifications that rely on different samples are used to explore such issues. In the most simple approach I use a panel approach that compares all places regardless of their proximity to to a WiC. Here there is little provision for the possibility that WiCs are systematically targeted towards places except to the extent that I can control for these differences using the controls detailed above ('selection on observables'). Subsequent specifications use difference-in-difference strategies that counter endogenous location by only looking only at places that already have a WiC, did so in the past, or will do so in the future. Estimates are based on localised changes in ED attendances in places close to walk in centres when the availability of walk in services changes, against a control group provided by other places that similarly have (or had, or will have) walk in centres close by, but where the availability of walk in services does not change at that particular time.

[13] See Gibbons et al. (2014) for a discussion. In addition, I focus on places rather than people. As noted in Faggio (2014) it is typically harder to find a good control group for places rather than people and by focusing on places inevitably creates uncertainties since people can move in response to policy changes i.e. they can spatially sort in a non-random way.

Because the HES data only runs from 2008/9, in the small area models from which I generate my baseline results, WiC impacts must necessarily be estimated largely off changes in the availability of the third wave WiCs known as Darzi centres (see Table 2). These centres were commissioned under a policy initiative which prescribed criteria for facility location and the specification of services, and can be distinguished from other WiCs as they offer a registered GP service as well as walk in services. The exact timing of individual centres openings for these WiCs was largely determined by administrative factors. Because the identifying assumptions are that the factors driving the placement of any given WiC should be common to the placement of all WiCs (i.e. common trends), and that the timing of the treatment is not related to underlying factors that drive outcomes, a strategy that relies on making comparisons only between places with a wave 3 centre arguably provides the most comprehensive attempt to address endogenous placement concerns. For these models the control group is composed of areas in close proximity to WiCs opened only after 2008q2.

5 Results

Descriptive statistics in Table 3 are provided for the (log) number of overall attendances at EDs and the counts of WiCs in distance bands for each of the panels. This Table refers to information used in the main models i.e. only including those observations that were included in the sample, excluding duplicates, observations with incomplete data or with low counts of attends.

5.1 ED Attendances and Endogenous WiC Placement

Given that a key aim of the WiC program was to divert patients from EDs, I initially explore the effect of WiCs on ED attendances focusing first on endogenous WiC placement and the strategies I adopt to counter resulting biases.

Table 4 reports the provider-based model which provides a first pass. The dependent variable is quarterly counts of ED attendances at NHS Trusts 2004q2 to 2011q3 and the treatment measure counts WiCs in distance bands centred on the EDs. Three specifications are reported. In each case standard errors are clustered at the NHS Trust level and all specifications include quarter dummies and year-by-distance band dummies, with the final column additionally including year-by-region dummies to account for unobserved regional trends. The first column reports the results of a time-demeaned panel that includes all 146 NHS Trusts that have a hospital with a Type 1 facility with columns 2 and 3 reporting difference-in-difference models (where the sample is defined as the 123 NHS Trusts that have at least one Emergency Department within the third quartile (p75) travel distance from at least one of the 209 Walk In Centres that were opened or closed at some point in the panel time-frame). Looking across the columns, these results suggest that once the endogenous location of WiCs is taken into account, WiCs co-located at Emergency Departments appear to have a more economically and statistically significant impact on attendances at associated EDs, with the point estimates suggesting an effect of around 7%. For all other WiCs – i.e. those located away from EDs – no statistically significant effect of WiCs on the volume of ED visits can be detected.

Table 5 repeats this analysis using Lower Super Output Areas (LSOA) as the cross-sectional identifier and the more detailed HES data for 2009q2 to 2012q2. Relative to the provider based models above, these small area models permit a much finer consideration of the location of patents relative to WiC services, with the greater granularity providing more observations and greater variation on which to base estimates.[14] Columns (1) and (2) are fixed effect models using the whole sample of LSOAs. The final two columns are difference-in-difference models that include in the sample only those LSOAs that are within the third quartile distance of an ED that opened or closed after 2008q1 for the reasons given above. The second of each pair of columns includes quarter-by-year fixed effects. Comparing the last two columns against the first two, findings broadly mirror the NHS Trust model, and are consistent with targeted locations experiencing increasing attendances prior to the policy intervention. I turn to interpretation in the next sections, from this point reporting results only from the difference in difference specifications which restrict attention to a subset of LSOAs that are within p75 travel distance of at least one WiCs opened after April 2008.

5.2 Attendances

Table 6 aims to evaluate the effect of WiCs on ED attendances. It reports results of LSOA models that relate counts of ED attendances in each LSOA in the sample to WiC entry and

[14] All further models are based on LSOAs. While subsequent specifications differ along at least one dimension, in all cases standard errors are clustered at the Middle Super Output Area (MSOA) level. MSOAs are a higher level of administrative geography built up from LSOAs. There are roughly 7,000 MSOAs in England which house populations of between 5,000 and 15,000.

exit, with the counts of attendances derived from the cleaned HES data.[15] The counts in columns (1)-(3) include attendance at EDs at any time while for the reasons set out below counts in columns (4)-(6) comprise only those visits that take place in normal WiC operating hours (8am to 8pm) but otherwise mirror (1)-(3). I adopt three specifications, each progressively adding more controls - the first includes quarter dummies and year-by-distance band, the second adds quarter-by-region dummies, and the third adds the natural log of the out of hours (OOH) attendance rate per 1,000 population in the LSOA as well as a set of population controls (LSOA population aged less than 10, aged 10-19, aged 20-49, aged 50-69, aged 70+). Columns 1 and 2 of this Table correspond to the first two columns of the previous one.

Three broad findings emerge from this Table that provide support for the idea that WiCs have a significant bearing on attendance volumes at EDs. Firstly, looking across the specifications, the majority of coefficients are of the expected direction and are significant at the 1% level. Although quantitative effects grows stronger when controlling for unobserved regional trends and weaken slightly with the introduction of the additional controls, the overall picture is qualitatively unchanged with the addition of the new controls. This holds in spite of a mechanical correlation in column (3) that arises because the OOH ED attendance rate is correlated with the dependent variable. Secondly, looking down each column in turn, it appears that ED WiCs bring about larger reductions in ED attendance volumes than for those outside EDs. For these latter WICs, proximity matters and works in a predictable way – the strongest impacts are evident in the closest LSOAs with effects roughly halving in the next buffer and tailing off to nothing in LSOAs beyond the median TTWA travel distance. Finally, the magnitude of coefficients grow when only considering the subset of attendances that occur during WiC opening hours (columns (4)-(6)) than for attendances at any time (columns (1)-(3)). In other words impacts at EDs are more evident during WiC opening hours, as one would expect.

The point estimates from these models can be used to roughly estimate the absolute effects of WiCs, and the extent to which WiCs divert patients from EDs or meet new demand. The mean number of ED attendances for LSOA-quarter cells in my main sample is 140. To get a feel for the overall effect, I apply the reductions implied by the point estimates for each buffer to this figure and then gross up by an estimate of the number of LSOAs it applies to. The average WiC in my data has 50 LSOAs in the first distance buffer, 50 more in the second, and a further 100 in the third. Using the estimates in column (3) I estimate that an average ED

[15] I providel robustness checks to provide assurance that data cleaning is not driving results. This includes the final two columns of Table 8 below and Table A1 in the Appendix.

WiC reduces quarterly ED attendances by 442 (= 0.0316 * 140 * 100) and the average WiC located elsewhere by 247 (= 0.0243 * 140 *50 + 0.0110 * 140 * 50). On the basis that the average WiC has roughly 20,000 annual attendances, this implies that around 9% of patients visiting an ED WiC and around 5% of those visiting a WIC elsewhere were diverted away from attending an ED.[16]

As WiCs cannot divert patients when they are closed, more meaningful estimates of the relevant average effects are arguably derived from column (6). Table 7 uses the point estimates and the upper and lower bounds of the 95% confidence interval to repeat the calculations above. As this table shows these estimates imply that the average number of patients diverted from attending an ED each year lie in the range 3,700 to 1,800 for ED WiCs and 960 - 2,000 for other WiCs. Using the same WiC attendance figure as above, these results would imply a diversion rate of between 10 and 20% for ED WiCs and 5 and 10% for other WiCs. Put another way, these rough calculations suggest that on average between 1 in 5 and 1 in 10 patients seen at ED WiCs and between 1 in 10 and 1 in 20 patients seen at other WiCs were diverted from attending an ED.

5.3 Attendances by Patient Arrival Method

In the next table (Table 8) I report results that exploit information contained in HES about how the patient came to be at the ED. Specifically, I distinguish between patients that are recorded as self-referring to the ED and that do not arrive in an ambulance (Self_Ref) and those patients that were either referred to the ED from another source — most commonly a GP — or were conveyed to the ED in an ambulance (Other). At face value, these latter patients had little choice in which facility they would attend. In column (1) I report the same specification as the final column of Table 6 for illustration i.e. using WiC hours only and the full set of controls. Repeating this specification for the two different patient groups separately in columns (2) and (3) suggests the impact of WiCs on self-referring patients is much sharper than for other patients. In fact, barring some slight noise, there is no significant effect evident for the other group. This group represents roughly half of all attendances, so it makes sense that the magnitude of the overall effect is roughly half the effect on the self-referred patient group reported in column (3).

[16]This is illustrative. Monitor (2014) reports that 70% of WiCs surveyed provide between 20,000 and 45,000 walk-in appointments per year but that attendances anticipated in commissioning contracts were typically in the range of 12,000 to 24,000 attendances.

One possible explanation for these contrasting results could be that the self-referred group of patients have less severe health needs and as such are able to attend lower acuity facilities more readily. This finds some support in the data since only 12% of the self referred group are admitted following their attendance compared to more than 40% of the other group. However, of the non-admitted patients roughly 30% for both groups leave the ED without any kind of treatment. This could suggest that medical practitioners such as GPs and ambulance staff are unwilling or unable to refer or convey patients with less severe health needs to WiCs rather than the ED. Whatever the reason for this discrepancy, it is clear that if the other group responded to WiCs in the same way as the self-referring group, the effect of WiCs on diverting patients could potentially be larger by up to a factor of around 2.

The final two columns of Table 8 utilise the Self and Other patient groups in a way to support the estimates in the preceding Tables. In particular, they are designed to allay any concerns that sample restrictions adopted to address deficiencies in the HES data are driving the overall patterns I find. In earlier results, LSOA-quarter cells with less than 50 attends were dropped. This was justified in order to avoid problems where organisations begin to report data which could appear as a spurious increase in attendances, as well as to avoid problems inherent in using count data. An alternative to dropping such cells is to retain these them and instead to control for changes in reporting patterns. To do so I use dependent variables that combine information about attendances in Self_Ref and Other groups. The rationale here is that changes in reporting should affect both of these equally sized groups more or less symmetrically. More generally, differencing between choice and non choice attends controls for *any* unobserved LSOA quarter factors that affect attendances by both groups equally and so provides a powerful check on earlier results.

Two specifications are reported in Table 8. In column (4) I use the ratio of Self_Ref to All attendances and in column (5) the difference between the logarithm of Self_Ref and Other attendances. As Other attendances appear to be uncorrelated with WiCs, the estimated effects should be driven by the effects of WiCs on Self_Ref counts. In both cases the pattern of effects is as found in earlier Tables, providing some reassurance that these overall effects are robust to using the whole sample of LSOAs.

5.4 Heterogeneous Effects of WiCs

The models in this subsection explores whether different WiCs might have heterogeneous effects depending on their specific settings, with a focus on whether and how the availability of other health care services locally might condition impacts. I do so by interacting the counts of WICs in distance buffers by time-invariant variables that indicate (a) where the WiC is the only WiC in the TTWA (Isolated) and (b) where WiCs are located in areas with relatively few GPs (UnderDr). I proxy for the latter by using areas that were eligible for additional GP surgeries under the EAPC policy which sought to address inequality issues in access to primary care by setting up around 100 new GP surgeries in the most under-doctored areas in England.

Results from the interaction models are reported in Table 9. As previously, column (1) of this Table reports the same specification as the final column of Table 6 for reference. Looking across the Table it is clear that the interactions are generally significant and imply results that are intuitively appealing. Column (2) indicates that where a WiC is the only one serving a population its effects on ED attendances are quantitatively larger for more far flung patients, and estimates from column (3) that in areas with the lowest GPs per population WiC effects are materially larger across all distance buffers. These estimates are consistent with WiCs having greater effects on ED attendances where there are fewer health care substitutes available, and suggest that policies that target new services to such areas could be more effective in reducing pressures on hospital emergency services.

5.5 Admissions

My fourth set of results relates to the effects of WiCs on ED admissions and is reported in Table 10. This repeats the analysis of Table 6 but replaces the dependent variable with counts of admissions rather than attendances. Again, the first three columns use counts at any time while the final three use counts only in the hours of 8am - 8pm. Looking across the Table, it is apparent that the pattern of estimates is less clear down rows, less stable across columns, and coefficient estimates are less economically and statistically significant than for the attendance based models. This is unsurprising – WiCs have no facility to admit patients and were not designed to reduce the number of emergency admissions at hospitals per se, so there is less of a direct link between the availability of walk in services and ED admissions than for ED attendances. However, significant coefficients for some variables provides some support that

WiCs may have modest effects in bringing down the number emergency admissions. This is further supported by the increase in economic and statistical significance when contrasting admissions at any time (columns (1)-(3)) and admissions in WIC operating hours (columns (4)-(6)).

The scale of the impact of WICs outside EDs on admissions via EDs is relatively small with significant estimates suggesting effects of the order 0.5-1%. Unexpectedly, the effects do not exhibit the clear spatial pattern evident for ED attendances although this may reflect imprecision of estimates for different buffers and it is difficult to rule out that the coefficients are not the same across buffers. ED based WiCs consistently display parameter estimates that are larger than those for other WiCs. One possible explanation for the larger estimates for ED WiC effects may follow from hospital administrators responses to managing performance against nationally set waiting time targets that aim to ensure a high proportion of patients are seen within four hours of arriving at an emergency care facility. This target provides incentives for hospitals to admit patients who are close to breaching the target (since an admission signals the end of the patient's attendance in the ED). It is possible that the increased capacity associated with a new co-located WiC may reduce the need for managers to make such decisions in order to stay within the target.

5.6 Disentangling the effects of WiC and GPs

As a final extension I aim to disentangle whether the effects evident in earlier results are the outcome of changes in the availability of walk in services or primary care services. This is worthwhile as the majority of results have necessarily been estimated on a subset of WiCs that opened since 2008/9. These WiCs may not be representative of WiCs in general as by definition many of these centres (so-called Darzi centres) must comprise both a WiC and a regular GP practice. As such, and given little systematic evidence of the effects of GP access on ED attendances, it is unclear whether any earlier findings are driven by the walk in service or simply the improved access to GP services. I attempt to disentangle these effects by examining the impact of new GP surgeries that opened under the EAPC policy program. As described above, around 100 new GP practices were opened under this policy in areas of the country that had the lowest concentration of GPs. Using information provided by NHS England, I am able to identify 98 EAPC practices that were opened on or after 1st April 2008.

In Table 11 I repeat the regressions in the columns (1) and (3) of Table 6 and of Table 10 but using these GP practices rather than WiCs to construct treatment measures. I am unable to include regional trends in these regressions since I do not have enough variation to separately identify these from the changes in GP accessibility driven by this policy. Notwithstanding, these results suggest that GP practices may have small effects on ED attendances but these effects are restricted to LSOAs in the closest proximity to the new practices. The estimates suggest that less than a quarter of the overall effect of the Darzi WiCs is due to the impact of improving access to traditional GP services.[17] Although estimated effects on ED admissions are stable and intuitively signed making them seem plausible, they are too economically small to detect statistical significance.

6 Discussion and Conclusions

This research has attempted to evaluate the impacts of NHS Walk In Centres on attendances and admissions at hospital Emergency Departments with a specific focus on the extent to which these facilities divert patients away from EDs or attract new patients. There are several inherent problems in undertaking such research, not least there is no single comprehensive dataset on emergency patient activity, nor a single database on the population of WiCs. Beyond these data issues, interpreting any estimated effects as causal impacts must be approached cautiously since the availability of walk in services from a given location is the outcome of a series of decisions made by health administrators about the opening, placement and closing of such facilities, and as such could be endogenous to ED outcomes.

In order to circumvent these problems, I adopted a research design that focused primarily on comparing ED outcomes for populations living in small areas lying close to at least one of a wave of centres that was introduced from 2009/10, relying on the staggered introduction of the new facilities driven by administrative constraints on the deployment of the new services to facilitate a causal interpretation.

Across all local models I consistently find the availability of walk in services to have a significant effects on reducing overall volumes of attendances at Emergency Departments. Findings also suggest that WiC impacts are driven by diverting those patients who are recorded as having

[17]To facilitate a direct comparison I base this comparison on the estimates for WiCs in EAPC areas shown in column (3) of Table 9.

made the decision about where to attend an emergency care facility on their own, being neither referred nor arriving in an ambulance. In contrast, the local availability of WiCs seems to have had no effect on volumes of attendances that result from a referral or that arrive by ambulance. The reasons for the zero effect for these patients is unclear. It may be that these patients require the kind of services that an ED can provide but a WiC can not, but may also suggest an unwillingness of other health professionals to refer (or in the case of ambulances, bring) patients to WiCs rather than EDs.

A range of further results suggest that characteristics of WiCs may be important conditioning factors in determining the extent to which they divert patients from EDs. Centres based at hospitals next to EDs result in more pronounced falls in ED attendances than those located away from hospitals. This is perhaps unsurprising because at least some hospitals rely on a triage system at the front door where nurses direct patients either to the ED or to the WiC. For facilities away from hospitals, distance appears to matter with the strongest impacts evident for groups of patients living closest to the centres. Results are also consistent with more pronounced impacts in more isolated areas and in areas where the availability of GPs is lowest.

Estimating effects only during WiC opening hours, my findings imply that the average number of patients diverted from attending an ED each year lie in the range 1,800-3,700 for ED WiCs and 960-2,000 for other WiCs. Using an estimate of average annual attendances at WICs, results imply a diversion rate of between 10 and 20% for ED WiCs and 5 and 10% for other WiCs. Put another way, this implies between 1 in 5 and 1 in 10 patients seen at ED WiCs and between 1 in 10 and 1 in 20 patients seen at other WiCs being diverted from attending an ED. It should be noted that these results are rough calculations based on a coarse average WiC attendance figure and can not fully account for capacity issues at WiCs, so should be interpreted with caution. However, they do seem plausible given in surveys around a quarter of patients state that they would have attended an ED in the absence of a WiC.

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Appendix

This Appendix provides robustness checks on the results presented in the body of the paper.

Table A1 evaluates the sensitivity of results to different data cleaning operations. For each pair of columns the left-hand column includes quarter dummies, year-by-distance band dummies, and quarter-by-region dummies with the right-hand column adding including the additional controls used in the main results. The first two columns use the raw data extracted from HES. The subsequent two columns include results for counts of attends at EDs that have been cleaned, i.e. by dropping observations before 2009q2 and also reassigning type for fields where the type field is blank by reference to the QMAE data. The final two columns report results where counts have gone through the more stringent data process that reassigns type where QMAE suggests the type field may have been incorrectly coded. Looking across the Table, it is clear that the use of the cleaned and reassigned data gives rise to a more coherent pattern of the effects of WiCs over the raw data since more proximate LSOAs are more affected by the availability of WiC services. It is comforting that the two cleaning processes produce similar outcomes, although the strength of coefficients is lower when using the reassigned data. This finding is consistent across later findings but for simplicity in the main body of the paper I present only models based on the more conservative cleaning procedure.

A further robustness check explores alternative specifications for the distance buffers, using fixed distance buffers and buffers based on the distribution of travel distances aggregated to PCTs and LAs rather than TTWAs. As shown in Table A2 results are not materially changed by changing the construction of distance buffers except where a fixed distance is used. The results in this case show positive effects of WiCs at greater distances. This likely reflects that travel distances are higher for cities than in the other models presented here. For patients living at these longer distances, there is likely little real prospect of using WiCs at such distances.

Figure 1: Outcomes of ED attendances, 2009-2011

Notes: Based on HES data for all Emergency Department attendances in the period 2008q2 through 2012q3. Admitted patients are defined as those with HES Attendance Disposal field value of 01. Untreated defined as those with HES A&E Treatment fields that all take the value of 99 or missing.

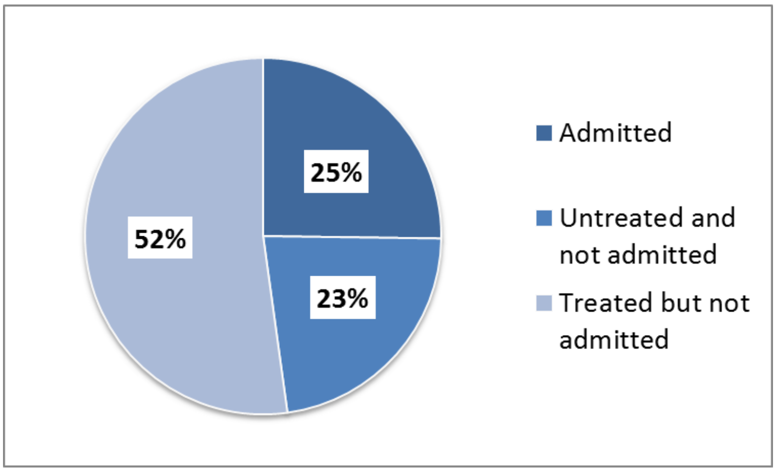

Table 1: Walk In Centres in England

Type	At ED	Away from ED	Total
Nurse-led	12	71	83
GP-led	16	129	145
-Darzi (wave 3)	13	122	135
-Commuter (wave 2)	0	6	6
-Other	3	7	10
Total	28	200	228

Table 2: Walk In Centre Openings and Closing, Sample Variation by Data Source

	QMAE (2004q3 - 2011q2)				**HES (2008q2 - 2012q3)**			
	Opened		Closed		Opened		Closed	
Type	ED	Non ED	ED	Non ED	ED	Non ED	ED	Non ED
Nurse-led	4	37	2	10	0	11	6	14
GP-led	16	127	2	11	15	122	2	15
-Darzi	13	121	1	6	13	121	1	9
-Commuter	0	6	0	5	0	0	0	6
-Other	3	0	1	0	2	1	1	0
Total	20	164	4	21	15	133	8	29

Figure 2: Walk In Centres in England, quarters from 1999q3

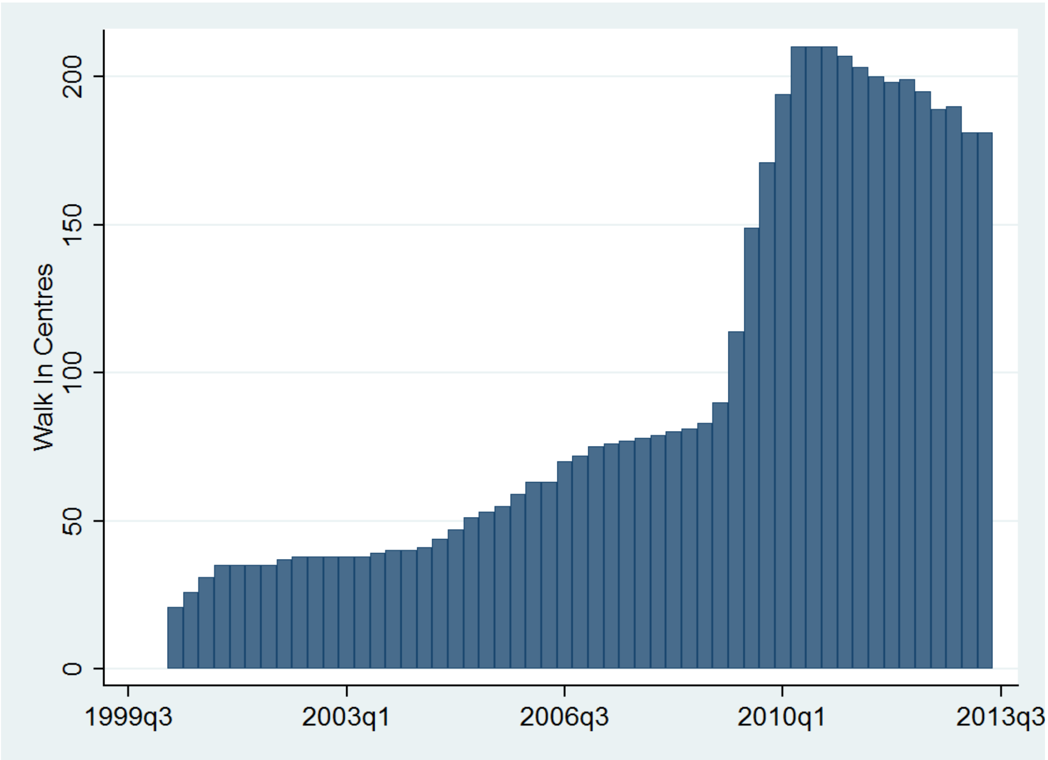

Figure 3: Attendances per thousand population by Type, 2004/5 to 2012/13

Notes: Source: HSCIC

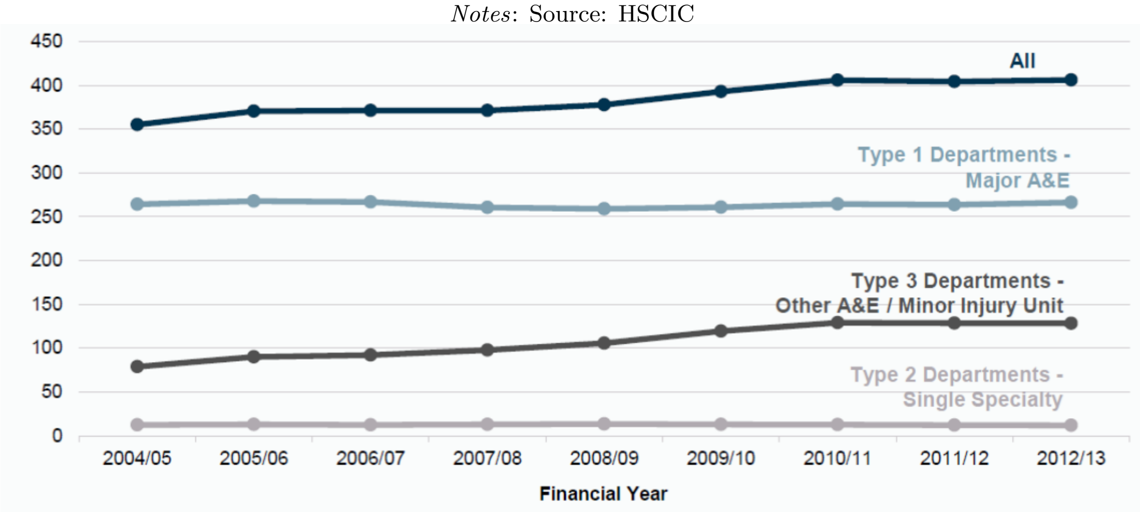

Figure 4: Alternative explanations for observed attendance patterns

Notes: The top part of the figure shows the situation with inelastic demand. A outward shift in supply caused by new WiCs initially reduces the cost of patient attendance from P0 to P1 (LHS) but an exogenous outward shift in demand means the new equilibrium pushes up quantity and prices to Q1 and P2 (RHS). The same outcome can come about with elastic demand as shown in the bottom part of the figure.

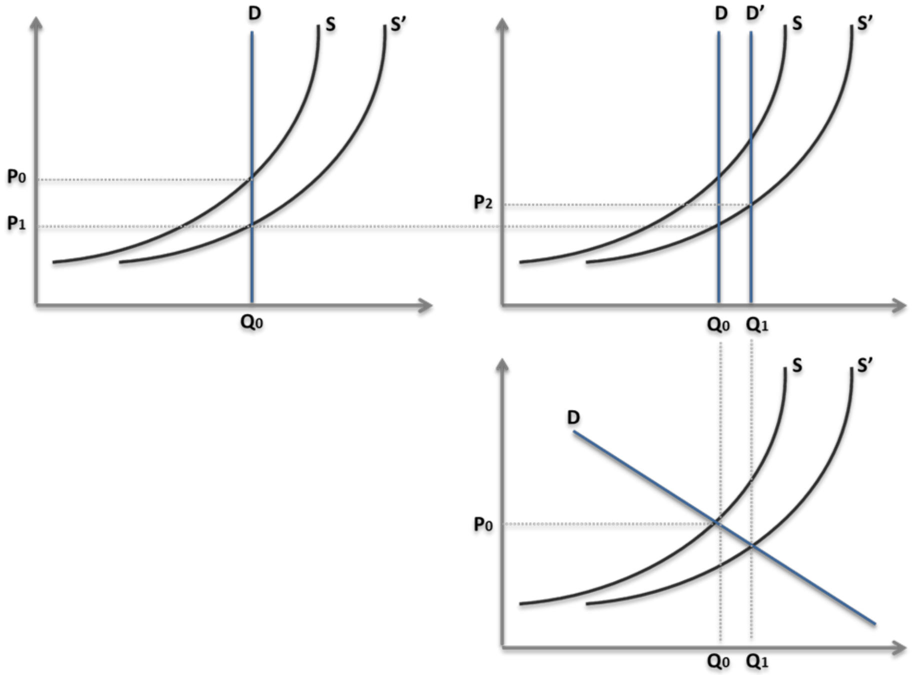

Figure 5: Walk In Centres in England

Notes: Green circles represent open WiCs; red circles closed ones.

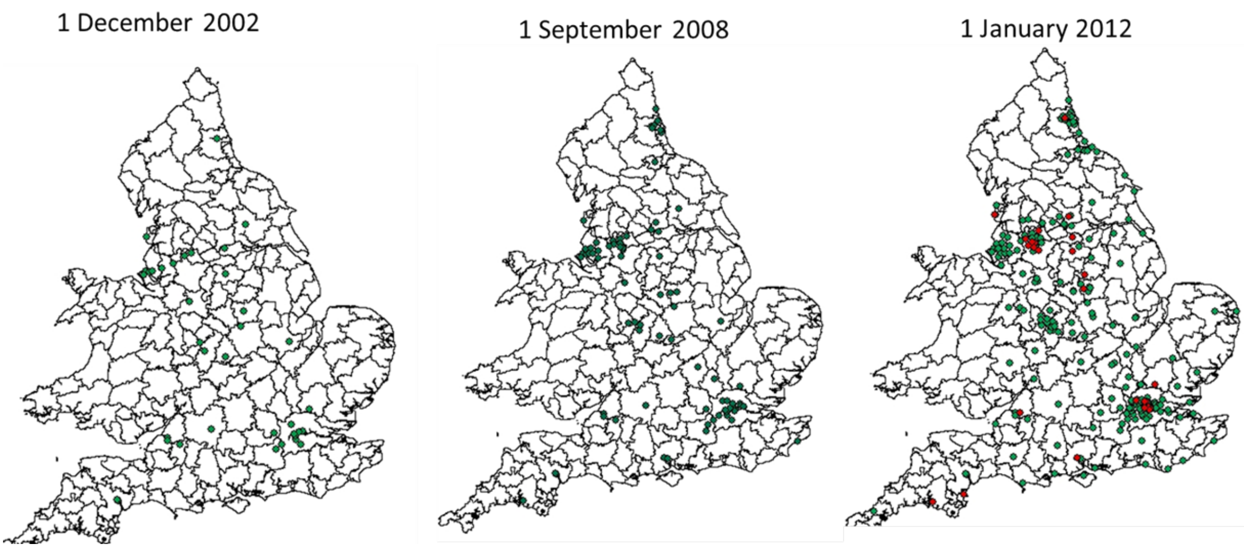

Figure 6: HES data before and after cleaning

Notes: Cleaning based on reassigning TYPE based on QMAE provider-quarter cells

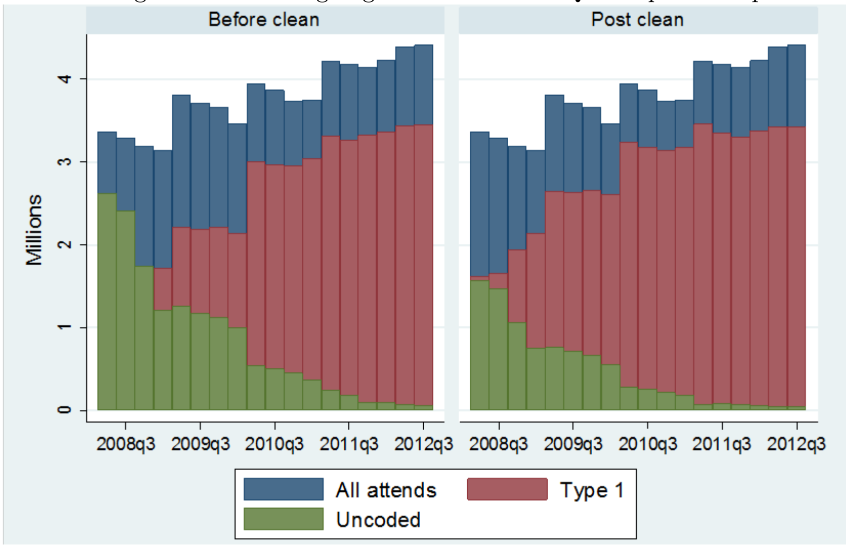

Figure 7: Proportion of QMAE A&E attends in HES

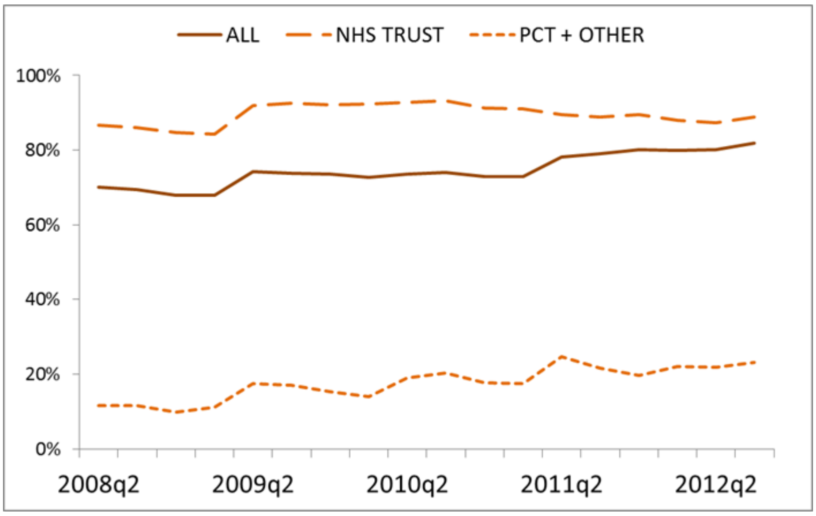

Table 3: Descriptive Statistics

	Mean	S.D	Min	Max
NHS Trust Model				
ln ED attends	10.01	0.42	8.91	11.29
ED WiCs within p0-p75	0.14	0.36	0	2
WiCs within p0-p25	0.22	0.45	0	2
WiCs within p25-p50	0.27	0.52	0	3
WiCs within p50-p75	0.41	0.78	0	6
Observations	3,660			
Lower Super Output Area (LSOA) Model				
ln ED attends (All_Hours)	4.89	0.30	4.00	7.53
ln ED attends (WiC_Hours)	4.53	0.32	0.69	7.12
ln ED attends (Self_Ref)	4.01	0.34	0	6.19
ln ED attends (Other)	3.53	0.50	0	6.77
ED WiCs within p0-p50	0.05	0.23	0	1
WiCs within p0-p25	0.28	0.50	0	5
WiCs within p25-p50	0.33	0.53	0	3
WiCs within p50-p75	0.73	0.94	0	8
Observations	128,147			

Table 4: WiCs and ED attendances, NHS Trust results

	(1) FE	(2) DD	(3) DD
ED WICs	-0.0338**	-0.0691***	-0.0692***
	(0.0171)	(0.0263)	(0.0254)
p0-p25 WICs	-0.0089	-0.0076	-0.0113
	(0.0161)	(0.0163)	(0.0154)
p25-p50 WICs	0.0004	0.0028	-0.0008
	(0.0244)	(0.0247)	(0.0239)
p50-p75 WICs	-0.0128	-0.0120	-0.0102
	(0.0136)	(0.0136)	(0.0151)
Year-by-Region FX			✓
N	4290	3660	3660
r2	0.949	0.943	0.946

Notes: Column (1) is a panel type analysis of 146 NHS Trusts. Columns (2) and (3) are difference-in-difference models with the sample defined by all 123 NHS Trusts with at least one ED within p75 travel distance from at least one of the 209 WiCs opened or closed at some point in the period 2004Q2 2011Q3. Dependent variables are log of ED attends. All regressions include quarter dummies and year-by-distance band dummies. Standard errors are clustered at the NHS Trust level.*** p < 0.01, ** p <0.05, * p < 0.1

Table 5: WiCs and ED attendances, LSOA

	(1) FE	(2) FE	(3) DD	(4) DD
ED WICs	-0.0138*	-0.0192***	-0.0195**	-0.0304***
	(0.0071)	(0.0071)	(0.0086)	(0.0086)
p0-p25 WICs	-0.0117***	-0.0156***	-0.0221***	-0.0249***
	(0.0039)	(0.0038)	(0.0048)	(0.0048)
p25-p50 WICs	-0.0003	-0.0049	-0.0085**	-0.0129***
	(0.0032)	(0.0032)	(0.0039)	(0.0039)
p50-p75 WICs	0.0060**	0.0010	0.0059**	0.0005
	(0.0025)	(0.0024)	(0.0027)	(0.0027)
Q-by-Region FX		✓		✓
Popn Age Bands				
N	203944	203944	128147	128147
r2	0.856	0.857	0.851	0.852

Notes: For all columns quarter-LSOA cells with fewer than 50 attends are dropped. Columns (1) & (2) are fixed effects model that include all 21,766 remaining LSOAs. Columns (3) & (4) are difference-in-difference models that restrict the sample to all 12,911 LSOAs within p75 travel distance from a WiC opened or closed after 2008q1. Dependent variables are in logs and constructed using cleaned ED attends. All regressions include quarter dummies and year-by-distance band dummies. Standard errors clustered at the MSOA level: *** p < 0.01, ** p <0.05, * p < 0.1

Table 6: WiCs and ED attendances, LSOA difference-in-difference models

	(1) All_Hours	(2) All_Hours	(3) All_Hours	(4) WiC_Hours	(5) WiC_Hours	(6) WiC_Hours
ED WICs	-0.0195**	-0.0304***	-0.0316***	-0.0294***	-0.0472***	-0.0496***
	(0.0086)	(0.0086)	(0.0060)	(0.0086)	(0.0093)	(0.0088)
p0-p25 WICs	-0.0221***	-0.0249***	-0.0243***	-0.0338***	-0.0368***	-0.0371***
	(0.0048)	(0.0048)	(0.0035)	(0.0055)	(0.0055)	(0.0053)
p25-p50 WICs	-0.0085**	-0.0129***	-0.0110***	-0.0104**	-0.0161***	-0.0159***
	(0.0039)	(0.0039)	(0.0028)	(0.0045)	(0.0045)	(0.0042)
p50-p75 WICs	0.0059**	0.0005	0.0002	0.0072**	-0.0003	-0.0005
	(0.0027)	(0.0027)	(0.0019)	(0.0031)	(0.0030)	(0.0029)
OOH Attend Rate			0.3864***			0.0875***
			(0.0060)			(0.0169)
Q-by-Region FX		✓	✓		✓	✓
Popn Age Bands			✓			✓
N	128147	128147	128147	128147	128147	128147
r2	0.851	0.852	0.911	0.778	0.783	0.786

Notes: All columns are difference-in-difference models with the sample defined by all 12,911 LSOAs within p75 travel distance from a WiC opened or closed after 2008q1, dropping quarter-LSOA cells with fewer than 50 attends. Dependent variables are in logs and constructed using cleaned ED attends. All_Hours include attends taking place at any time, WiC_Hours only between 8am and 8pm. All regressions include quarter dummies and year-by-distance band dummies. Standard errors clustered at the MSOA level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 7: Diversion from EDs, WiC open hours

	(1) 95% C.I (-)	(2) Point Estimate	(3) 95% C.I (+)	LSOAs
ED WICs	-0.0668	-0.0496	-0.0323	100
p0-p25 WICs	-0.0473	-0.0371	-0.0267	50
p25-p50 WICs	-0.0241	-0.0159	-0.0076	50
p50-p75 WICs	N/A	N/A	N/A	100
ED WiC Annual Diversion	3714	2728	1809	
ED WiC Diversion Rate	19%	14%	9%	
Other WiC Annual Diversion	1999	1484	960	
Other WiC Diversion Rate	10%	7%	5%	

Table 8: WiCs and ED attendances, by arrival method

	(1) Baseline	(2) Self_Ref	(3) Other	(4) Self/All	(5) Self-Other
ED WICs	-0.0496***	-0.0826***	-0.0001	-0.0371***	-0.1299***
	(0.0088)	(0.0115)	(0.0139)	(0.0061)	(0.0259)
p0-p25 WICs	-0.0371***	-0.0580***	0.0026	-0.0191***	-0.0853***
	(0.0053)	(0.0070)	(0.0067)	(0.0025)	(0.0124)
p25-p50 WICs	-0.0159***	-0.0295***	0.0096*	-0.0123***	-0.0560***
	(0.0042)	(0.0056)	(0.0054)	(0.0023)	(0.0107)
p50-p75 WICs	-0.0005	-0.0024	0.0039	-0.0044**	-0.0204**
	(0.0029)	(0.0041)	(0.0040)	(0.0017)	(0.0081)
OOH Attend Rate	0.0875***	0.0452**	0.1396***		
	(0.0169)	(0.0184)	(0.0161)		
Q-by-Region FX	✓	✓	✓		
Popn Age Bands	✓	✓	✓		
N	128147	128147	128147	296422	296422
r2	0.786	0.719	0.809	0.512	0.562

Notes: All columns are difference-in-difference models with the sample defined as before. Dependent variables are constructed using cleaned ED attends taking place between 8am and 8pm. Dependent variables are in logs except column (4) which is a ratio of two levels. Self_Ref counts self referred patients not arriving by ambulance. Other counts attends for those patients that arrived by ambulance or that were referred from another source. Counts are of attends taking place between 8am and 8pm only. All regressions include quarter dummies and year-by-distance band dummies. Standard errors clustered at the MSOA level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 9: WiCs and ED attendances, treatment heterogeneity

	(1) Baseline	(2) Isolated	(3) UnderDr
ED WICs	-0.0496***	-0.0496***	-0.0484***
	(0.0088)	(0.0088)	(0.0087)
p0-p25 WICs	-0.0371***	-0.0356***	-0.0288***
	(0.0053)	(0.0062)	(0.0054)
p25*interact		-0.0055	-0.0307***
		(0.0075)	(0.0088)
p25-p50 WICs	-0.0159***	-0.0125***	-0.0115**
	(0.0042)	(0.0046)	(0.0047)
p50*interact		-0.0227***	-0.0172**
		(0.0070)	(0.0072)
p50-p75 WICs	-0.0005	0.0008	0.0043
	(0.0029)	(0.0032)	(0.0033)
p75*interact		-0.0093*	-0.0251***
		(0.0049)	(0.0051)
OOH Attend Rate	0.0875***	0.0875***	0.0871***
	(0.0169)	(0.0169)	(0.0169)
Q-by-Region FX	✓	✓	✓
Popn Age Bands	✓	✓	✓
N	128147	128147	128147
r2	0.786	0.786	0.787

Notes: All columns are difference-in-difference models with the sample defined as before. Dependent variables are in logs and constructed using cleaned ED attends taking place between 8am and 8pm. Interactions are binary variables taking the value of 1 if the LSOA is in a TTWA with a single WiC (column (2)) or if the LSOA is in a PCT eligible for additional GP practices under the EAPC policy (column (3)). All regressions include quarter dummies and year-by-distance band dummies. Standard errors clustered at the MSOA level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 10: WiCs and ED admissions

	(1) All_Hours	(2) All_Hours	(3) All_Hours	(4) WiC_Hours	(5) WiC_Hours	(6) WiC_Hours
ED WICs	-0.0103	-0.0162*	-0.0126*	-0.0125	-0.0198**	-0.0234**
	(0.0088)	(0.0088)	(0.0065)	(0.0100)	(0.0099)	(0.0100)
p0-p25 WICs	0.0002	-0.0020	-0.0016	-0.0015	-0.0058	-0.0053
	(0.0050)	(0.0050)	(0.0040)	(0.0060)	(0.0060)	(0.0061)
p25-p50 WICs	-0.0025	-0.0053	-0.0054*	-0.0058	-0.0106**	-0.0098**
	(0.0038)	(0.0039)	(0.0032)	(0.0047)	(0.0048)	(0.0048)
p50-p75 WICs	-0.0020	-0.0050*	-0.0051**	-0.0041	-0.0090***	-0.0088***
	(0.0025)	(0.0026)	(0.0021)	(0.0029)	(0.0031)	(0.0031)
OOH Admit Rate			0.2764***			-0.0457***
			(0.0025)			(0.0039)
Q-by-Region FX		✓	✓		✓	✓
Popn Age Bands			✓			✓
N	120393	120393	120393	120393	120393	120393
r2	0.651	0.653	0.754	0.557	0.559	0.562

Notes: All columns are difference-in-difference models with the sample defined by all 13,607 LSOAs within p75 travel distance from a WiC opened or closed after 2008q1, dropping quarter-LSOA cells with fewer than 25 attends. Dependent variables are in logs and constructed using cleaned ED admissions taking place between 8am and 8pm. All regressions include quarter dummies and year-by-distance band dummies. Standard errors clustered at the MSOA level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 11: New GP practices and ED attendances and admissions

	(1) Attend	(2) Attend	(3) Admit	(4) Admit
p0-p25 EAPCs	-0.0148***	-0.0138***	-0.0083	-0.0084
	(0.0050)	(0.0047)	(0.0063)	(0.0064)
p25-p50 EAPCs	-0.0005	0.0008	-0.0043	-0.0031
	(0.0045)	(0.0041)	(0.0052)	(0.0053)
p50-p75 EAPCs	-0.0007	-0.0012	0.0002	0.0016
	(0.0031)	(0.0029)	(0.0036)	(0.0036)
OOH Attend Rate		0.1488***		
		(0.0096)		
OOH Admit Rate				-0.0216***
				(0.0045)
Q-by-Region FX				
Popn Age Bands		✓		✓
N	71154	71154	70279	70279
r2	0.810	0.819	0.574	0.576

Notes: Samples and dependent variables defined as in earlier Tables. Treatment intensity constructed using GP practices opened under the Equitable Access to Primary Care (EAPC) policy. All regressions include quarter dummies and year-by-distance band dummies. Standard errors clustered at the MSOA level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A1: WiCs and ED attendances, data cleaning robustness

	(1) Raw	(2) Raw	(3) Cleaned	(4) Cleaned	(5) Reassign	(6) Reassign
ED WICs	0.4885***	0.4893***	-0.0304***	-0.0316***	-0.0263***	-0.0272***
	(0.1142)	(0.1148)	(0.0086)	(0.0060)	(0.0088)	(0.0061)
p0-p25 WICs	-0.1304***	-0.1305***	-0.0249***	-0.0243***	-0.0190***	-0.0184***
	(0.0302)	(0.0301)	(0.0048)	(0.0035)	(0.0048)	(0.0035)
p25-p50 WICs	-0.0607**	-0.0572**	-0.0129***	-0.0110***	-0.0097**	-0.0077***
	(0.0262)	(0.0260)	(0.0039)	(0.0028)	(0.0039)	(0.0028)
p50-p75 WICs	0.0054	0.0063	0.0005	0.0002	0.0002	-0.0000
	(0.0137)	(0.0135)	(0.0027)	(0.0019)	(0.0026)	(0.0019)
OOH Attend Rate		0.3569***		0.3864***		0.3836***
		(0.0094)		(0.0060)		(0.0060)
Q-by-Region FX	✓	✓	✓	✓	✓	✓
Popn Age Bands		✓		✓		✓
N	128096	128096	128147	128147	128147	128147
r2	0.633	0.647	0.852	0.911	0.851	0.908

Notes: All columns are difference-in-difference models with the sample defined by all 12,911 LSOAs within p75 travel distance from a WiC opened or closed after 2008q1, dropping quarter-LSOA cells with fewer than 50 attends. Dependent variables are logs of attend counts at any time. Columns (1)(2) use raw counts; (3)-(4) use counts where type has been cleaned; (5)-(6) counts where types have been reassigned based on QMAE data. All regressions include quarter dummies and year-by-distance band dummies. Standard errors clustered at the MSOA level: *** p < 0.01, ** p <0.05, * p < 0.1

Table A2: WiCs and ED attendances, buffer construction robustness

	(1) TTWA	(2) PCT	(3) LA	(4) Fixed
ED WICs	-0.0496***	-0.0490***	-0.0487***	-0.0286***
	(0.0088)	(0.0080)	(0.0084)	(0.0062)
p0-p25 WICs	-0.0371***	-0.0351***	-0.0338***	-0.0150***
	(0.0053)	(0.0054)	(0.0052)	(0.0034)
p25-p50 WICs	-0.0159***	-0.0189***	-0.0204**	0.0136***
	(0.0042)	(0.0046)	(0.0043)	(0.0024)
p50-p75 WICs	-0.0005	0.0008	-0.0014	0.0047***
	(0.0029)	(0.0030)	(0.0033)	(0.0017)
OOH Attend Rate	0.0875***	0.0764***	0.0841***	0.0865***
	(0.0169)	(0.0176)	(0.0179)	(0.0141)
Q-by-Region FX	✓	✓	✓	✓
Popn Age Bands	✓	✓	✓	✓
N	128147	123471	117160	153913
r2	0.786	0.783	0.785	0.791

Notes: All columns are difference-in-difference models with the sample defined by all LSOAs within p75 travel distance from a WiC opened or closed after 2008q1, dropping quarter-LSOA cells with fewer than 50 attends. Dependent variables are logs of attend counts taking place between 8am and 8pm. Column (1) is the baseline specification where buffers can vary at the TTWA level. Columns (2) & (3) buffers vary at the PCT and LA levels respectively. In column (4) distance buffers are set at the levels of the national average. All regressions include quarter dummies and year-by-distance band dummies. Standard errors clustered at the MSOA level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

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