

# The long-term impacts of new care models on hospital use: an evaluation of the Integrated Care Transformation Programme in Mid-Nottinghamshire

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## Key points

- This report presents the findings of an evaluation of the long-term impacts of the Mid-Nottinghamshire Better Together Integrated Care Transformation Programme (ICTP) over a 6-year period from its launch in April 2013 until March 2019. The programme was established by Mansfield and Ashfield clinical commissioning group (CCG) and Newark and Sherwood CCG, together with local partners. In March 2015, the Mid-Nottinghamshire Better Together programme achieved vanguard status as an integrated primary and acute care systems provider, one of the first of the new care models announced in the *Five year forward view*.<sup>1</sup>

- The ICTP programme contained several interventions, which changed over time. These included local integrated care teams; a 24/7 care navigation service ('Call for Care'); a home support service ('Intensive Home Support') that aimed to bridge the gap between acute and community services; an acute home visiting service to which GPs could refer patients; a proactive home care service providing integrated care in a care home setting; the introduction of an ambulatory and emergency care unit; and a programme to streamline elective referrals.
- Our evaluation considered the overall impact of these interventions over a 6-year period between April 2013 and March 2019. We compared the hospital use of the Mid-Nottinghamshire population with a synthetic control area, constructed from similar GP practices elsewhere in England.
- The ability to look over such a long term is important because integrated care programmes usually aim to reduce hospital admissions, yet previous evaluations have typically found mixed results in this respect.<sup>2,3,4,5,6,7,8</sup> Those evaluations were not able to examine the long-term impacts of integrated care, and it has been unclear from these evaluations whether reductions in hospital use might begin to materialise over a longer period.
- In the first 2 years of the programme, rates of A&E visits were higher in Mid-Nottinghamshire than the synthetic control area, by 3.9% in 2013/14 and 5.4% in 2014/15. After those 2 years the trends reversed, and by year 6 (2018/19) the Mid-Nottinghamshire population was experiencing 4.3% fewer A&E visits than the synthetic control area. This is equivalent to 14.2 fewer A&E visits per 10,000 people per month.
- Over time, Mid-Nottinghamshire also began to see fewer emergency hospital admissions: by the last year of our study (2018/19) there were 6.7 fewer of these per 10,000 people per month in Mid-Nottinghamshire than the synthetic control area (a 6.4% difference). During the last 2 years (2017/18 and 2018/19) there was a significant drop in the number of hospital admissions for urgent care sensitive conditions that can be managed by the urgent and emergency care system, accounting for 30-40% of the difference in emergency admissions, or between two and three admissions per 10,000 people per month.
- The higher rates of A&E visits seen in Mid-Nottinghamshire compared to the synthetic control area in the early part of the study were mainly driven by a higher level of use among people aged 65 years and over. The reduction in emergency admissions in the later part of the study was only evident for emergency admissions for urgent care sensitive conditions in the over 65s.
- From the third year of our study (2015/16) onwards, the length of overnight emergency hospital stays was shorter in Mid-Nottinghamshire than the synthetic control area, and the number of 30-day emergency admissions was also lower. Mid-Nottinghamshire saw higher rates of elective admission than the synthetic control area in the fourth and fifth years of our study (2016/17 and 2017/18), and higher rates of outpatient appointments during the first 4 years (2013/14 to 2017/18).
- One of the challenges when evaluating the impact of integrated care over such a long time period is that it is hard to be sure which interventions caused the change. However, the long-term pattern of impacts observed here may be consistent with better management of care in the community, the provision of more responsive, coordinated and streamlined care, and improved access to services.
- The higher rates of A&E visits in Mid-Nottinghamshire compared to the synthetic control area seen in the early years of the programme may be the result of the local integrated care teams identifying urgent needs for health care that might otherwise have remained unmet or been identified later.
- It may be that over time the interventions matured, resulting in the reductions in A&E visits, emergency admissions, length of stay and readmissions in the last few years of the study. The higher rates of elective admissions in the over 65s may reflect a number

of phenomena including a greater awareness of unmet need among GPs and patients as a result of the Local Integrated Care Teams (LICTs) or the programme of elective care.

- While the results are promising, it is important to note the limitations of the study, including the possibility that there were systematic differences between Mid- Nottinghamshire and the synthetic control area that explained the findings. We selected the synthetic control area in such a way that it had a similar history of hospital use to Mid-Nottinghamshire but there may be differences we could not observe (for example, in their degree of family support, social isolation, disease severity, or ability to manage health conditions) and therefore could not be accounted for in the analyses. Further research is needed regarding the long-term impacts of integrated care, including qualitative data that sheds light about how each of the individual components were implemented and the surrounding context, and quantitative analysis on outcomes other than hospital use.
- Our evaluation, spanning 6 years of the ICTP, provides promising evidence that integrated care programmes have the potential to reduce hospital use over the long term, even if there are increases in the shorter term. It may take time for new ways of working to become embedded and unmet needs for care may be discovered. Our results emphasise the importance of being realistic about how long it will take to see results and that early assessment of impacts risks erroneous conclusions that may lead policymakers to question or abandon potentially effective initiatives.

## Background

Integrated care aims to improve patient care and experience by ‘joining up’ care more closely between GPs, hospitals, community services and social care.<sup>6</sup> Integrating health and social care may be effective in reducing hospital admissions and associated health care costs of patients with complex and long-term conditions.<sup>7,8</sup> Evaluation of the impacts of integrated care projects over the last 10 or more years have indicated mixed results in this respect.<sup>2,3,4,5,6,7,8</sup> However, those evaluations were not able to examine the long-term impacts of integrated care, and it has been unclear from these evaluations whether reductions in hospital use might begin to materialise over a longer period.

This report presents the findings of an evaluation of the long-term impacts of the Mid-Nottinghamshire Better Together Integrated Care Transformation Programme (ICTP) over a 6-year period from its launch in April 2013 until March 2019.

### **The Mid-Nottinghamshire Better Together Integrated Care Transformation Programme**

Mansfield & Ashfield (M&A) CCG and Newark & Sherwood (N&S) CCG are responsible for commissioning health care on behalf of the people of Mansfield, Ashfield, Newark and Sherwood in Mid-Nottinghamshire. M&A CCG has 27 GP practices and N&S CCG has 14.<sup>\*</sup> Together they serve a population of approximately 329,000<sup>†</sup> individuals with an age structure slightly older than the national average. The older population is more likely to experience disability and long-term illnesses and there are increasing numbers of individuals with multiple comorbidities or who need complex care. There are high levels of deprivation across both urban and rural areas giving rise to an increasing demand for health and social care.

\* [www.nhs.uk/Services/Trusts/GPs/DefaultView.aspx?id=89801](http://www.nhs.uk/Services/Trusts/GPs/DefaultView.aspx?id=89801) and [www.nhs.uk/services/trusts/gps/defaultview.aspx?id=89804](http://www.nhs.uk/services/trusts/gps/defaultview.aspx?id=89804)

† ONS March 2018 Mid-year estimate.

In April 2013, the Mid-Nottinghamshire Better Together ICTP was launched in partnership with M&A CCG, N&S CCG, Nottinghamshire County Council, Sherwood Forest Hospitals NHS Trust and other partners to develop a joined-up way of working for better health and social care outcomes for the population of Mid-Nottinghamshire.

In March 2015, the Mid-Nottinghamshire Better Together programme achieved vanguard status as an integrated primary and acute care systems (PACS) provider, one of the first of the new care models vanguards announced in the *Five year forward view*.<sup>1</sup> The aim of PACS was ‘to join up services to allow better decision-making and more sustainable use of resources, with a greater focus on prevention and integrated community based care, and less reliance on hospital care’.<sup>9</sup> The vanguard funding was used to support the ongoing ICTP in delivering new models of health and social care to transform the delivery of health and social care and drive system-wide financial benefits. An alliance contract\* was agreed from April 2016 entering the partners into a contractual joint venture for a 3-year period until March 2019. The Mid-Nottinghamshire Alliance now operates as an Integrated Care Partnership as part of the Nottingham and Nottinghamshire Integrated Care System (ICS). Successful elements of the ICTP are now a key part of the changes being rolled out more widely to support the overarching ICS priorities.

The ICTP was launched in April 2013 and comprised four main work programmes.<sup>10</sup> The Proactive and Urgent Care programme comprised interventions focused on long-term conditions, emergencies and urgent health problems. The Elective Care programme comprised a collection of approaches designed to improve elective referrals and processes.

The Mental Health and Community Delivery programme included workstreams such as proactive mental health, mental health core contract and community services core contract. The Women and Children’s programme included interventions relating to acute paediatrics, maternity service specification, community paediatrics and urgent paediatric surgery.<sup>11</sup>

See Box 1 for an overview of the ICTP and Figure 1 for a chronology of key interventions.

## Box 1: Overview of the Better Together Integrated Care Programme

### Proactive and Urgent Care

- Local Integrated Care Teams (LICTs), introduced in N&S CCG in April 2013 and rolled out to M&A CCG in April 2014, worked with patients at high risk of future admission including those with long-term conditions, the frail elderly and cancer patients. Services were coordinated around the needs of an individual patient. Multidisciplinary teams (MDTs) conducted monthly meetings to review care plans for current patients and to identify new patients. The aim was to support people to be independent with expected reductions in hospital admissions and length of stay. There were eight LICTs with an annual caseload of approximately 10,000 patients in total.

\* An Alliance contract is a contractual arrangement between commissioners and an alliance of partners who deliver the services. See [www.kingsfund.org.uk/sites/default/files/media/linda-hutchinson-alliance-contracting-27.03.14\\_0.pdf](http://www.kingsfund.org.uk/sites/default/files/media/linda-hutchinson-alliance-contracting-27.03.14_0.pdf) for more details.

- A Self-Care hub introduced in September 2013 was provided by Self Help UK as part of the LICT to support people to access services and information that helped them with self-care.<sup>12</sup> The aim was to increase the number of patients able to manage their long-term conditions in the community. The Self-Care hub was less well embedded than other interventions in early 2017 and was decommissioned in November 2017.
- Call for Care was introduced in November 2015 as a care navigation service for health and social care professionals offering urgent, same-day community alternatives to hospital admissions. Call for Care offered clinical triage and could arrange a response from community clinicians within two hours. The service was extended to the East Midland Ambulance Service (EMAS) in 2015, and later to GPs and out-of-hours care professionals. Call for Care also included a crisis response team (also called the Rapid Intervention Team) which operated 24/7 to support patients at home until other services could be initiated. Call for Care was designed for an annual caseload of 11,600 calls and was expected to reduce A&E visits and emergency admissions.
- Intensive Home Support, introduced in M&A CCG in September 2015 and rolled out to N&S CCG in January 2018, was a multidisciplinary health and social care service operating 24/7 to bridge the gap between acute and community services. It coordinated with the LICTs to provide rehabilitation, medical monitoring and nursing care for patients being discharged from hospital. Intensive Home Support was expected to reduce emergency admission and delays in discharge and enable more effective patient flows through the system.
- Improved A&E streaming by creating a 'single front door' at co-located A&E and Primary Care Service departments in King's Mill Hospital in April 2016. The single front door was intended to improve patient experience through simplified access and efficient clinical streaming thus easing pressure on the A&E department and reducing emergency admissions.
- The acute home visiting service (N&S CCG April 2017) was a primary care-led scheme where GPs could refer patients with acute needs. The service was expected to reduce A&E visits and emergency admissions.
- A proactive care home service provided proactive and integrated case management of patients within a care home setting. The service, which was expected to cut emergency admissions and A&E visits, was piloted in 2016 and rolled out in mid-2017.
- An ambulatory emergency care (AEC) unit was set up at King's Mill Hospital in June 2016. The AEC unit managed up to 28% of patients requiring emergency medical care. In June 2017 a number of pathways at King's Mill Hospital were mobilised for management by primary care and community services with the aim of further reducing emergency admissions and time spent in hospital.<sup>25</sup>
- High-volume service user multidisciplinary team. Focusing on proactive care planning for the 'Top 100' cohort of highest users of A&E beginning in August 2017.

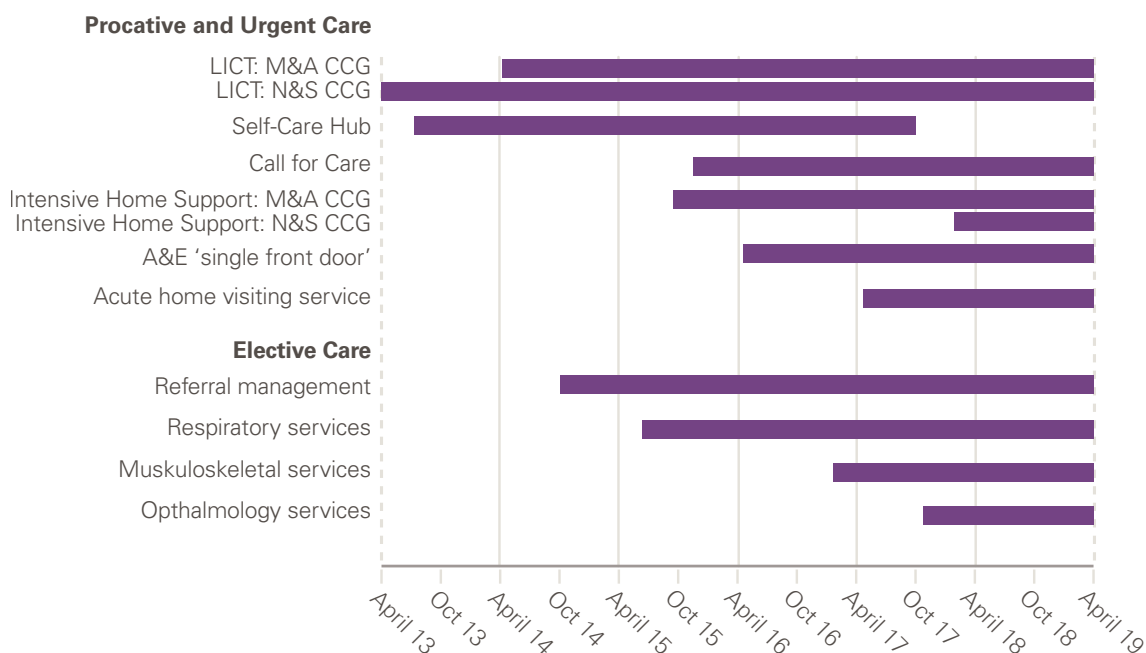
### **Elective Care**

- An elective referral management programme introduced in October 2014 aimed to standardise the way that referrals were managed. This included an administrative team who worked with patients to take account of their preferences and to ensure appointment times and travel were convenient.
- Musculoskeletal services introduced in January 2017 provided a single point of access for patients to combine physiotherapy, rheumatology, chronic pain management and elective orthopaedic services into a single coordinated service in line with NHS RightCare methodology.<sup>26</sup>
- Ophthalmology services introduced in October 2017 provided community-based services including community monitoring for patients with eye conditions that required ongoing management.
- Respiratory services introduced in June 2015 provided home oxygen review and assessment services, pulmonary rehabilitation sessions and respiratory nurse-led clinics in line with NHS RightCare methodology.<sup>26</sup>

### Mental Health and Community and Women and Children

- Crisis Resolution and Home Treatment teams offered a 24/7 crisis resolution service for people with significant mental illness who would otherwise be admitted to hospital.
- A Rapid Response Liaison Psychiatry service operated across the region providing rapid assessment of patients who were referred due to concerns regarding their mental health, such as those who were self-harming, suicidal, in acute mental health crisis or with dementia or delirium.

**Figure 1: Chronology of key interventions in the Proactive & Urgent Care and Elective Care programmes**



Note: Dashed grey lines indicate the start and end of the study period. Dotted lines indicate financial years for which we report estimates of impact. M&A - Mansfield and Ashfield CCG; N&S - Newark and Sherwood CCG.

### What impact were these changes intended to have?

When taken together, these interventions were intended to create a new model of care, with a greater proportion of care provided at home and in the community, outside of acute hospital settings. Care professionals were encouraged to work together across organisational and professional boundaries to deliver improved outcomes and make efficiency savings. Key priorities for the ICTP included reducing A&E visits, inpatient admission and length of stay in hospital; reducing delays in the provision of care; enabling people to remain independent in their own homes; and facilitating timely transfer of care from hospital with intermediate care and reablement services.

## About this evaluation

This evaluation was conducted by the Improvement Analytics Unit – a partnership between the Health Foundation and NHS England and NHS Improvement that evaluates complex local initiatives in health care in order to support learning and improvement. The evaluation looked at the impact of the ICTP on the hospital use of the adult (aged over 18 years) population registered with GP practices in M&A and N&S CCGs\* over a 6-year period, spanning the introduction of the ICTP in April 2013 up to the end of the Alliance contract in March 2019.

Due to constraints with national data sets, this report is restricted to considering the impacts of the ICTP on hospital use, including A&E visits, emergency and elective admissions, emergency readmissions, elective and emergency length of stay and outpatient appointments. It could not examine whether there had been any improvements in the quality of clinical care, patient outcomes or quality of life.

To ensure rigour and transparency, the analysis was conducted according to a statistical analysis protocol<sup>13</sup> which was subjected to independent academic peer review and finalised before the analysis began.

## Approach to the evaluation

We adopted a population approach to the evaluation. This meant we examined hospital use for all adults registered with a GP in the Mid-Nottinghamshire region irrespective of whether they had been treated at hospitals operated by the local trust, or elsewhere (eg in the hospitals of a neighbouring trust). This approach was taken as the key interventions were mainly delivered at GP practice level. By including all hospital activity, we can provide a more comprehensive picture of the effect the ICTP had on health care for the local population.

As well as examining the hospital use of individuals aged over 18 years, we also considered people aged 65 or over. These individuals were more likely to be eligible for interventions such as the LICt, since 64.9% of people aged 65 or over have multiple health conditions.<sup>14</sup>

We compared the hospital use of the Mid-Nottinghamshire population with that of a control area. This approach differs from the approach that many organisations take to performance monitoring, which typically involves examining trends over time (for example comparing the rate of A&E visits before and after the introduction of the ICTP). While such a ‘before-and-after’ approach is useful for assessing whether metrics are changing over time, it cannot isolate the impact of the ICTP from the impact of other changes that were taking place in Mid-Nottinghamshire at the same time. In contrast, the control area in this analysis provided estimates of the hospital use that would have been expected in Mid-Nottinghamshire in the absence of the ICTP.

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\* Hereafter we refer to M&A and N&S CCGs as the Mid-Nottinghamshire CCGs; the GP practices in the Mid-Nottinghamshire CCGs as the treated group; the region covered by the Mid-Nottinghamshire CCGs as the Mid-Nottinghamshire region; and the population of patients aged over 18 years and registered with a GP practice in the Mid-Nottinghamshire CCGs as the Mid-Nottinghamshire population.

Finding the control area is challenging since no other part of England is exactly like Mid-Nottinghamshire. Instead, we formed a ‘synthetic control’ area by combining data from a donor pool of GP practices in other parts of England in a way that ensured the resulting area was similar to Mid-Nottinghamshire in terms of its historic trend in hospital use. The method is appropriate when an intervention affects an entire area and when data are available from several other areas. The Improvement Analytics Unit used a similar approach to evaluate the impact of redesigning urgent and emergency care in Northumberland.\* <sup>15</sup>

## Methods<sup>†</sup>

### Sources of data

#### Reference data

Data relating to the characteristics of CCGs and GP practices, including demographic and socio-economic factors, access to health care, and Quality and Outcomes Framework (QOF) measures, were collected from publicly available sources.<sup>‡</sup> We structured these data so that they provided a monthly data series of *reference data* for all CCGs and GP practices in England between April 2011 and March 2019. These data were used for risk adjustment and for comparing between CCGs and GP practices.

#### Activity data

Hospital activity data were obtained from the Secondary Uses Service (SUS), a national, person-level database that is closely related to the widely used Hospital Episode Statistics (HES)<sup>§</sup>. These data were collected between April 2011 and March 2019 for all patients aged over 18 years and registered at Mid-Nottinghamshire and donor pool GP practices. Data were then aggregated across patients registered at each GP practice to provide monthly series of *activity data* for each GP practice. These data were used to define impact metrics capturing monthly hospital use for the population of patients registered at each GP practice in England<sup>¶</sup>. These data were also used to define variables for risk adjustment and for comparing between CCGs and GP practices: these include historic trends in hospital use and the characteristics (eg age, gender and comorbidities) of patients seeking care each month<sup>\*\*</sup>.

\* For more examples of the synthetic control approach see: [www.health.org.uk/publications/the-impact-of-redesigning-urgent-and-emergency-care-in-northumberland](http://www.health.org.uk/publications/the-impact-of-redesigning-urgent-and-emergency-care-in-northumberland)

† For more information see the technical appendix at: [https://www.health.org.uk/sites/default/files/2020-09/TechnicalAppendix\\_NewCareModels.pdf](https://www.health.org.uk/sites/default/files/2020-09/TechnicalAppendix_NewCareModels.pdf)

‡ See Table 1 in the technical appendix.

§ The Improvement Analytics Unit has access to SUS data for its work and processes them in a secure environment based at the Health Foundation. All data are pseudonymised, meaning they have been stripped of all fields that could be used to identify patients directly, such as name, date of birth and address. Individuals’ NHS numbers are replaced with a pseudonym, which the unit used to link records for the same individual over time. The overall approach to information governance was scrutinised by the programme oversight group and by information governance experts at NHS Digital.

¶ See Table 2 in the technical appendix.

\*\* See Table 3 in the technical appendix.



## Selecting the donor pool

We began by selecting 500 GP practices in England that were most similar to the GP practices in Mid Nottinghamshire at both a regional (CCG) and a local (GP practice) level in the 24-month period leading up to the start of the ICTP in April 2013. We did this in two stages:

- **Selecting comparable CCGs**  
There are 209\* CCGs in England. At the outset we excluded 30 CCGs in London, two other CCGs in Mid-Nottinghamshire and 59 vanguard CCGs participating in the new care models programme†. This left 118 CCGs, which we characterised in terms of selected variables that were predictive of hospital use, eg number of GPs per capita and the prevalence of common disease. The similarity of each of these CCGs to the Mid-Nottinghamshire CCGs was assessed across all these variables and the most similar 40 CCGs to each of the Mid-Nottinghamshire CCGs were selected. This resulted in a unique set of 69 distinct CCGs. In this group of CCGs there were 1,820 GP practices.
- **Selecting comparable GPs**  
The 1,820 GP practices were also then characterised in terms of the same variables predictive of hospital use and the similarity of each of these GP practices to the GP practices in Mid-Nottinghamshire was assessed as described for the CCGs. To allow for the most relevant comparison at this stage, greater weight was placed on variables that were more predictive of hospital admissions.

The most similar 500 GP practices formed the basis for the selection of the synthetic control area. More detail on the variables used and the selection method can be found in the technical appendix.‡

## Impact metrics

The SUS data were used to define impact metrics assessing how the population of each GP practice used hospital care between April 2011 and March 2019. We used a range of impact metrics to capture impacts on hospital use. See Table 1 for a full list.

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\* For data drawn March 2019.

† This included primary and acute care systems, multispecialty community providers, enhanced health in care homes, and urgent and emergency care, as well as CCGs linked to two acute care collaborations – the Salford and Wigan Foundation Chain and the Healthcare Group in Dartford and Gravesham.

‡ For more information see the technical appendix.

**Table 1. Impact metrics and risk-adjustment strategy. All impact metrics were analysed in the main analysis. A subset of the impact metrics was used in a subgroup analysis for patients aged over 65 years: these included rate of A&E visits, emergency and elective admissions, emergency admissions urgent care sensitive conditions and for chronic ambulatory care sensitive conditions, 30-day emergency readmissions and outpatient appointments. ACSCs=Ambulatory care sensitive conditions.**

Impact metric	Interpretation	Risk adjustment	Comment
Rate of A&E visits	Number of A&E attendances per 10,000 registered GP practice patients	Population	Includes A&E departments 'Type 1' (major, consultant-led 24-hour services with full resuscitation facilities) and 'Type 3' (minor injury, walk-in and specialty departments)
% of A&E visits where the patient is seen within 4 hours	Practice patients	A&E activity	This includes attendances at any trust and therefore differs from any trust-level A&E performance measures reported monthly by NHS England
% of A&E visits that resulted in an emergency admission	Percentage of A&E visits where the patient is admitted, transferred or discharged within 4 hours of arrival at A&E	A&E activity	
Rate of emergency admissions	Percentage of A&E visits that resulted in an emergency admission	Population	Includes admissions from patients who originally presented at A&E as well as those admitted to hospital directly following an urgent request from a GP. Analysed separately for chronic ACSCs, urgent care sensitive conditions and excluding both these potentially avoidable admission types, as identified by the primary diagnosis in the admission record
Rate of elective admissions	Number of emergency admissions per 10,000 registered GP practice patients	Population	
Average LOS of overnight emergency admission	Number of elective admissions per 10,000 registered GP practice patients	Inpatient activity	Includes all patients with an emergency admission initiated in the month

Impact metric	Interpretation	Risk adjustment	Comment
% of emergency admissions with a LOS less than 1 day	Expected length of stay for a registered GP practice patient	Inpatient activity	Includes all patients with an emergency admission initiated in the month
Average LOS of overnight elective admission	With an emergency admission of at least 1 day	Inpatient activity	Includes all patients with an elective admission initiated in the month
% of elective admissions with a LOS less than 1 day	Percentage of emergency admissions where the patient is admitted for less than 1 day	Inpatient activity	Includes all patients with an elective admission initiated in the month
Rate of 30-day emergency readmission	Expected length of stay for a registered GP practice patient	Inpatient activity	Includes all patients with an inpatient admission initiated in the month and all emergency readmissions even if unrelated to the original cause

We looked separately at emergency admissions that were potentially avoidable including those for chronic ambulatory care sensitive conditions (ACSCs) and urgent care sensitive conditions. We looked at these as we would expect the LICTs to have a greater impact on admissions for these conditions than others. The measures, which have overlapping conditions, are defined in the CCG Improvement and Assessment Framework.<sup>16</sup> In brief, chronic ACSCs are long-term conditions for which the risk of admissions may be reduced by timely and effective primary and community care. These include chronic viral hepatitis B, diabetes, anaemia, dementia, epilepsy, cardiovascular disease such as heart failure and angina, and respiratory disease such as asthma and bronchitis. Urgent care sensitive conditions are conditions that may sometimes be dealt with effectively by the urgent and emergency care system (such as ambulance services or A&E) without emergency admission, eg chronic obstructive pulmonary disease, acute mental health crisis, non-specific chest pain, hypoglycaemia, angina, epileptic fit, urinary tract infection, deep vein thrombosis and falls (aged 74 years and over).

### Estimating the impact of the ICTP

We used the generalised synthetic control method<sup>17</sup> to estimate the impact of the ICTP. This method uses mixed effects regression modelling to implicitly estimate a synthetic control area for each impact metric. Essentially, weights were given to the GP practices in the donor pool to allow the regression model to make the best prediction of the impact seen

in Mid-Nottinghamshire in the 24 months before the ICTP began. The rationale is that if the model could predict similar values of the impact metric over this long pre-intervention period, then it would continue to have predicted similar values in the absence of the ICTP. Intuitively, we can think of the weights as implicitly defining a synthetic control area which has trends in hospital use similar to Mid-Nottinghamshire in the pre-intervention period. This synthetic control area provides a best estimate regarding what would have happened to hospital use in Mid-Nottinghamshire had the ICTP not been implemented. For a detailed technical description of the generalised synthetic control method please refer to the technical appendix.\*

After forming the synthetic control areas, we estimated the impact of the ICTP, based on the differences seen in the impact metrics between Mid-Nottinghamshire and the relevant synthetic control area. We did this separately for each month between the start of the ICTP in April 2013 and March 2019. We estimated the impact of the ICTP in each financial year by averaging the estimates seen across all months in the financial year.

The variability of these estimates must also be assessed. This is important since outcomes vary over time even without changes to care delivery, and it would be misleading to attribute normal statistical variation to the effect of changes made. We do this by reporting the 'p-value', which is the probability that an effect of at least the magnitude observed could have arisen by chance. If this probability is low (eg less than 5%), then the findings are usually considered to represent a systematic difference between the two groups.

### **Risk adjustment**

Over such a long period of study, and because of the ICTP, the profile of a GP practice with regard to patient, practice and local area characteristics is likely to change. This might lead to changes in the characteristics of patients using hospital services. Hence impact metrics were risk adjusted for variables that reflect changes over time in the characteristics of the population at risk. For our impact metrics there were three possible groups of risk adjustment variables.

- **Population risk adjustment.** When looking at impact metrics such as A&E visits, inpatient admissions and outpatient attendances, all patients in the registered populations are at risk. We adjusted for variables describing the characteristics of the GP practice from the reference data, and for patient comorbidity from activity data.
- **A&E activity risk adjustment.** When looking at impact metrics such as the proportion of A&E visits where a patient is seen within four hours or emergency admissions following a visit to A&E, only patients already in A&E are at risk. We adjusted for variables describing the patient (eg age, gender, ethnicity and comorbidity) from activity data.

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\* For more information see the technical appendix at: [https://www.health.org.uk/sites/default/files/2020-09/TechnicalAppendix\\_NewCareModels.pdf](https://www.health.org.uk/sites/default/files/2020-09/TechnicalAppendix_NewCareModels.pdf)

- **Inpatient activity.** When looking at outcomes related to inpatient admissions, eg length of stay or emergency readmissions, only patients with an inpatient admission are at risk. We adjusted for variables describing the patient (eg age, gender, ethnicity, primary diagnosis code and comorbidity) from activity data.

See Table 1 for the risk adjustment strategy for each impact metric. More details on the precise variables used for risk adjustment of each outcome metric can also be found in the technical appendix.\*

### Assumptions and diagnostic tests

Modelling assumptions play an important role in the generalised synthetic control method. In particular, it is assumed that the post-intervention hospital use of the synthetic control area reflects the hospital use that would have occurred in Mid-Nottinghamshire in the absence of the ICTP. This might not be the case if there are unobserved differences between the two areas that could affect how the impact metrics change over time. To reduce this risk of bias, we were careful to form our synthetic control area using GP practices that were similar to those in Mid-Nottinghamshire. Matching intervention and donor pool GP practices according to characteristics we can observe may, in turn, provide indirect matching with variables that they are correlated with.<sup>18</sup> We created graphs to visualise the similarity between the intervention and donor pool GP practices to assess whether the assumptions underlying our method were likely to be valid.<sup>†</sup>

The quality of the synthetic control area is measured by how closely the impact metrics in Mid-Nottinghamshire and the synthetic control area track each other during the pre-intervention period. Intuitively, if they do not track well in the pre-intervention period, the synthetic control area is unlikely to be a good estimate of the counterfactual Mid-Nottinghamshire in the post-intervention period. We performed formal statistical tests looking at the differences between the impact metrics of the two areas in the pre-intervention period. If these found no evidence of a difference (p-value >0.05), then we judged the synthetic control area to provide a good fit.

For the majority of the impact metrics, our statistical tests found no evidence that the synthetic control area did not provide a good fit to the Mid-Nottinghamshire data. However, an adequate synthetic control area could not be found for two impact metrics (the percentage of A&E visits that resulted in an emergency admission and the percentage of emergency admissions with a stay of less than 1 day). These impact metrics were excluded from further analysis.

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\* For more information see the technical appendix.

† For more information see the technical appendix.

## Sensitivity analyses

When designing the evaluation, we made a number of choices, for example regarding the length of the pre-intervention period, the start date of the intervention, the variables included in the risk adjustment, and the number of GP practices included in the donor pool. We performed sensitivity analyses to explore how our findings would have varied if we had made different choices. These included:

- shortening the pre-intervention period used to determine the synthetic control area by setting the study date artificially 3 and 6 months earlier than the actual start date
- considering the importance of risk adjustment by estimating effects without risk adjusting the impact measures
- repeating the analysis with the most similar 250 and 1,000 GP practices in the donor pool.

Sensitivity analyses confirmed that the findings were robust to changes in how impact metrics were defined, the number of GP practices in the control group used to create the synthetic control, and the duration of time used to determine the weights for the synthetic control area. Please refer to the technical appendix for further details.\*

## Results

Figures 2–5 show the trends in hospital use for Mid-Nottinghamshire (red lines) and the synthetic control areas (blue lines). Note that the two lines are similar in the period prior to the start of the ICTP (ie to the left of the grey dashed line). This was by design, as we aimed to find synthetic control areas that tracked the hospital use of Mid-Nottinghamshire over this period.

The difference between the two lines in the post-intervention period (ie to the right of the grey dashed line) provides an estimate of the impact of the ICTP. These differences are summarised in Table 2, which shows the estimated impact of the ICTP on hospital use for each financial year following its introduction. Table 3 is similar but focuses on people aged over 65 years. Please also refer to Figure 1 in the technical appendix,† which shows an alternative view of the same data.

\* For more information see the technical appendix at: [https://www.health.org.uk/sites/default/files/2020-09/TechnicalAppendix\\_NewCareModels.pdf](https://www.health.org.uk/sites/default/files/2020-09/TechnicalAppendix_NewCareModels.pdf)

† See Figure 1 in the technical appendix.

**Table 2. Risk-adjusted estimated impact of the ICTP on hospital use in the population of the Mid-Nottinghamshire aged over 18 years, April 2013–March 2019. Rates are expressed per 10,000 adults per month. ACSCs=Ambulatory care sensitive conditions.**

Impact metric	Year 1 2013/14		Year 2 2014/15		Year 3 2015/16		Year 4 2016/17		Year 5 2017/18		Year 6 2018/19							
	Difference <sup>A</sup>	Rel. Difference (%) <sup>B</sup>	Difference	Rel. Difference (%) <sup>A</sup>	Difference	Rel. Difference (%) <sup>A</sup>	Difference	Rel. Difference (%) <sup>A</sup>	Difference	Rel. Difference (%) <sup>A</sup>	Difference	Rel. Difference (%) <sup>A</sup>						
Rate of A&E visits	9.7	3.9	<0.001	14.2	5.4	<0.001	9.5	3.5	0.06	7.4	2.7	0.13	-9.1	-3.2	0.17	-12.9	-4.3	0.048
% A&E visits seen within 4 hours	1.4	1.5	<0.001	-2.4	-2.6	0.05	0.3	0.4	0.41	0.5	0.5	0.48	-4.6	-5.1	0.06	-5.3	-5.6	0.13
Rate of emergency admissions	-0.5	-0.5	0.71	2.2	2.3	0.15	1.7	1.7	0.27	4.0	4.0	0.05	-5.4	-5.4	<0.001	-6.9	-6.4	<0.001
Rate of emergency admissions for chronic ACSCs	0.3	3.9	0.27	0.2	2.7	0.53	0.3	3.4	0.43	0.1	1.6	0.72	-0.1	-1.4	0.7	-0.6	-6.4	0.16
Rate of emergency admissions for urgent care sensitive conditions	1.2	5.6	0.01	0.3	1.2	0.58	0.7	3.1	0.19	1.7	7.3	0.01	-1.8	-8.3	<0.001	-2.9	-12.0	<0.001
Rate of emergency admissions for non-avoidable conditions	-1.7	-2.7	0.06	1.4	2.1	0.21	1.0	1.4	0.32	2.3	3.2	0.11	-3.6	-4.8	0.01	-3.9	-4.9	0.01

Impact metric	Year 1 2013/14		Year 2 2014/15		Year 3 2015/16		Year 4 2016/17		Year 5 2017/18		Year 6 2018/19							
	Difference	Rel. Difference (%) <sup>A</sup>	Difference	Rel. Difference (%) <sup>A</sup>	Difference	Rel. Difference (%) <sup>A</sup>	Difference	Rel. Difference (%) <sup>A</sup>	Difference	Rel. Difference (%) <sup>A</sup>	Difference	Rel. Difference (%) <sup>A</sup>						
Rate of elective admissions	-1.1	-0.7	0.49	0.5	0.3	0.82	3.8	2.3	0.1	6.6	3.9	0.01	11.2	6.9	<0.001	2.0	1.2	0.48
Average LOS (days) of emergency overnight admissions	0.4	5.2	<0.001	0.2	2.2	0.08	-0.3	-4.5	<0.001	-1	-12.2	<0.001	-0.6	-7.6	<0.001	-0.5	-7.0	<0.001
Average LOS (days) of elective overnight admissions	0.1	1.8	0.41	0.2	4.4	0.05	-0.2	-5.2	0.02	-0.2	-4.6	0.03	-0.04	-1.0	0.69	-0.4	-8.4	<0.001
% of elective admissions with a LOS less than 1 day	0.7	0.9	0.02	1.0	1.2	<0.001	0.2	0.2	0.53	1.6	1.8	<0.001	0.8	1.0	<0.001	1.0	1.2	0.01
Rate of 30-day emergency readmission	-0.3	-2.7	0.24	-0.1	-1.1	0.58	-0.4	-3.8	0.04	-0.7	-6.7	<0.001	-1.7	-14.8	<0.001	-1.4	-12.4	<0.001
Rate of 1st outpatient appointment	11.8	3.4	0.004	23.4	6.4	<0.001	9.7	2.5	0.16	22.0	5.3	0.004	6.2	1.6	0.48	-7.8	-1.8	0.32

<sup>A</sup> Relative (Rel.) Difference = Change in Mid-Nottinghamshire expressed as a percentage of the estimate in the synthetic control area.



**Table 3. Risk-adjusted estimated impact of the ICTP on hospital use in the population of the Mid-Nottinghamshire aged over 65 years, April 2013–March 2019. Results are shown for a control group of size N=500<sup>B</sup>. ACSCs=Ambulatory care sensitive conditions.**

Impact metric	Year 1 2013/14		Year 2 2014/15		Year 3 2015/16		Year 4 2016/17		Year 5 2017/18		Year 6 2018/19							
	P	Rel. Difference (%) <sup>A</sup>	P	Rel. Difference (%) <sup>A</sup>	P	Rel. Difference (%) <sup>A</sup>	P	Rel. Difference (%) <sup>A</sup>	P	Rel. Difference (%) <sup>A</sup>	P	Rel. Difference (%) <sup>A</sup>						
Rate of A&E visits	16.8	5.3	0.002	21	6.2	<0.001	14.1	4.1	0.01	15.9	4.4	0.02	2.1	0.5	0.82	-2	-0.5	0.86
Rate of emergency admissions	-2.6	-1.3	0.48	2.4	1.2	0.33	4.3	2.1	0.21	12.3	5.9	<0.001	-4.3	-2	0.37	-6.9	-3.1	0.23
Rate of emergency admissions for chronic ACSCs	0.3	1.5	0.7	-0.2	-0.6	0.96	0.4	1.7	0.71	0.4	1.6	0.67	0.1	0.5	0.93	-1.9	-7.2	0.12
Rate of emergency admissions for urgent care sensitive conditions	1.3	3	0.33	-0.8	-1.8	0.5	1.4	3.1	0.32	2	4.5	0.19	-3.8	-9	0.01	-3.9	-8.8	0.02
Rate of elective admissions	-0.4	-0.1	0.93	-7.2	-2.6	0.1	5.7	2.1	0.28	22.8	8.2	<0.001	39.6	14.7	<0.001	42.1	14.7	<0.001
Rate of 30-day emergency readmission	-0.4	-3.8	0.44	0.2	1.5	0.37	0.005	0.04	0.65	-0.4	-3.3	0.79	-1.5	-11.3	0.56	-1.6	-12.8	0.57
Rate of 1st outpatient appointment <sup>B</sup>	21.8	4.3	0.01	38.9	7.1	<0.001	26.1	4.5	0.1	48.1	7.7	0.01	23.6	4.1	0.14	13.4	2	0.5

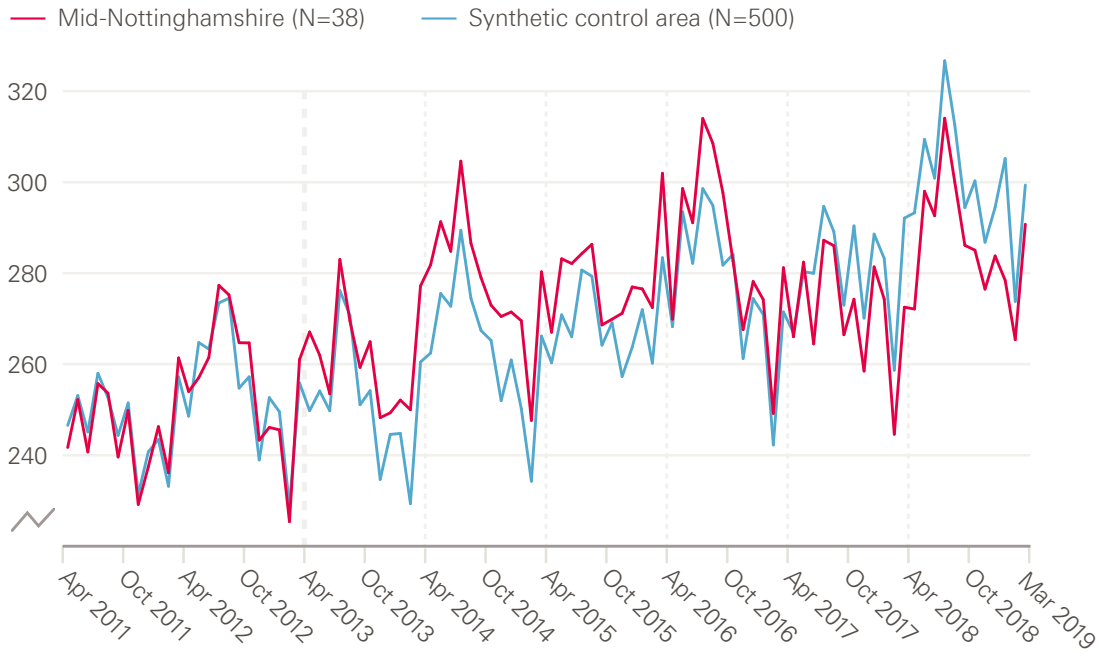
<sup>A</sup> Relative (Rel.) difference = Change in Mid-Nottinghamshire expressed as a percentage of the estimate in the synthetic control area.

<sup>B</sup> Results for a synthetic control area of size N=250.

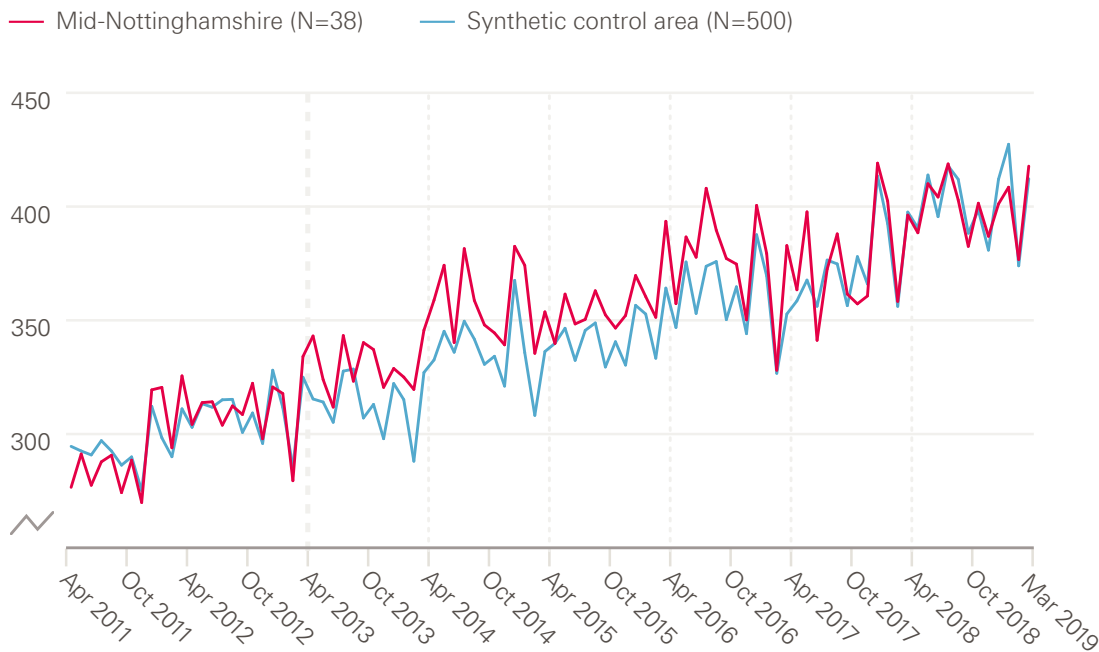
*Mid-Nottinghamshire patients had higher rates of A&E visits in the first 2 years of the ICTP than the synthetic control area, but trends reversed and rates were lower in the last 2 years*

**Figure 2: The impact of the ICTP on A&E visits. Red lines show observed values for the Mid-Nottinghamshire population and blue lines show estimated values for the synthetic control area.\***

**A. Rate of A&E visits (number per month per 10,000 people aged >18 years)**

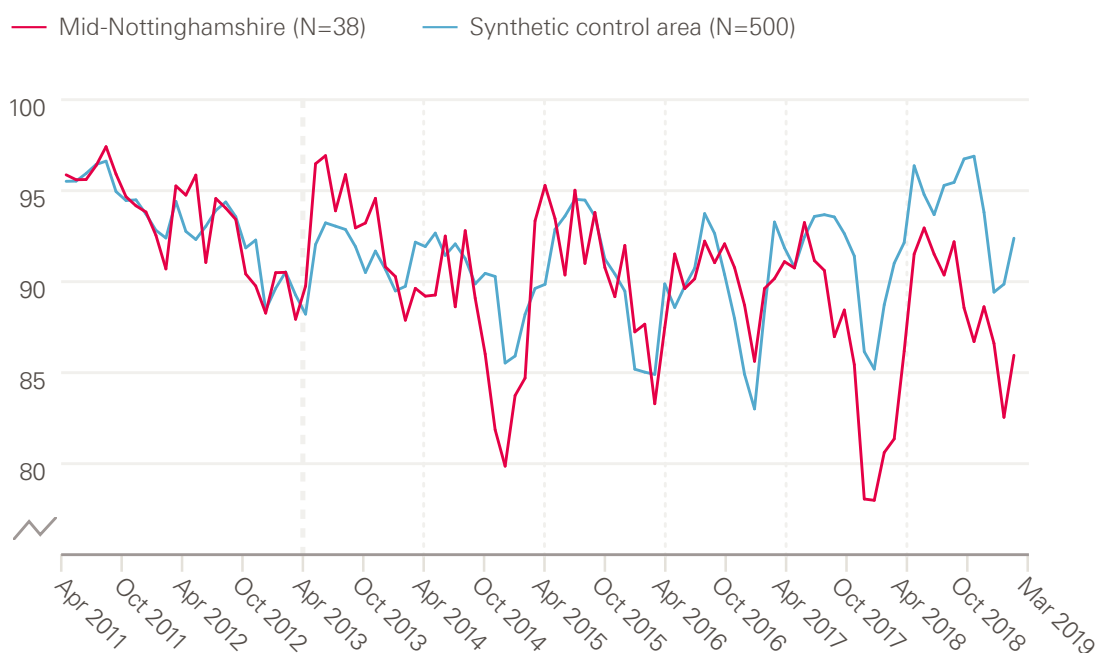


**B. Rate of A&E visits (number per month per 10,000 people aged >65 years)**



\* Note: Dashed grey line indicates the start of the intervention period. Dotted lines indicate financial years for which we report estimates of impact.

### C. Proportion of patients seen within 4 hours in A&E visit (% of people aged >18 years)



In 2013/14, the year after the introduction of the ICTP, Mid-Nottinghamshire saw 9.7 more A&E visits per 10,000 people per month than the synthetic control area (relative difference (RD)\*: 3.9%,  $p < 0.001$ ). In 2014/15, this difference increased to 14.2 (RD: 5.4%,  $p < 0.001$ ) – see Figure 2A and Table 2. This trend then reversed, so that by the last year in 2018/19, there were 12.9 (RD: 4.3%,  $p = 0.048$ ) fewer visits per month for the Mid-Nottinghamshire population than the synthetic control area. Since the estimated p-values are less than 0.05, we can be more than 95% confident that these findings reflect a real change in the outcomes as a result of the ICTP, rather than being down to chance.

Among people aged over 65 years the higher rates of A&E visits seen in Mid-Nottinghamshire compared to the synthetic control area persisted for 4 years. For these people, A&E rates were 16.8 higher in 2013/14 (RD: 5.3%,  $p = 0.002$ ), 21.0 higher in 2014/5 (RD: 6.2%,  $p < 0.001$ ), 14.1 higher in 2015/6 (RD: 4.1%,  $p < 0.001$ ) and 15.9 higher in 2016/7 (RD: 4.4%,  $p = 0.02$ ) – all expressed as monthly averages per 10,000 people, see Figure 2B, Table 3. There was no significant difference in the rate of A&E visits among people aged over 65 years in Mid-Nottinghamshire compared to the synthetic control area in the last 2 years of the study.

If we assume that roughly 25%<sup>19</sup> of the adult population are aged over 65 years, then approximately 37–43% of the additional visits in the adult population in the first 2 years of the study can be attributed to those aged over 65 years.<sup>†</sup>

\* The relative difference indicates the change in the Mid-Nottinghamshire population as a percentage of the estimated value in the synthetic control area.

† For example, in 2013/14, the ICTP was associated with 9.7/10,000 more A&E visits in the adult population of Mid-Nottinghamshire. If approximately 25% of the adult population is aged over 65 years<sup>19</sup>, then the 16.8/10,000 more A&E visits in the Mid-Nottinghamshire population aged over 65 years represents  $16.8 \times 0.25 / 9.7 = 43\%$  of the difference in the adult population.

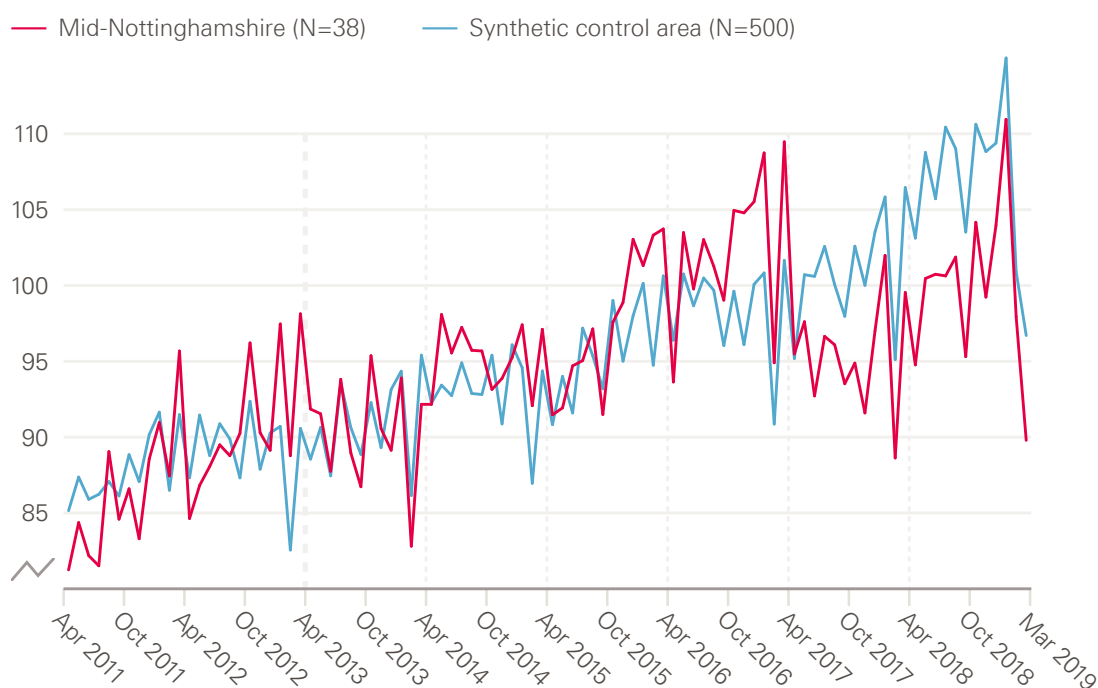
*More patients in Mid-Nottinghamshire were seen within 4 hours in A&E in the first year of the ICTP than the synthetic control area*

The percentage of patients attending A&E who were admitted, transferred or discharged within four hours of arrival increased sharply in Mid-Nottinghamshire when the ICTP began, from approximately 89% to 97%. Compared with the control area, the percentage was 1.4% higher in Mid-Nottinghamshire in 2013/14 (RD: 1.5%,  $p < 0.001$ ) (Figure 2C, Table 2). In subsequent years, there were no significant differences in the percentage of A&E visits lasting less than four hours between Mid-Nottinghamshire and the synthetic control area.

*Mid-Nottinghamshire patients had lower rates of emergency admissions from April 2017 onwards than the synthetic control area*

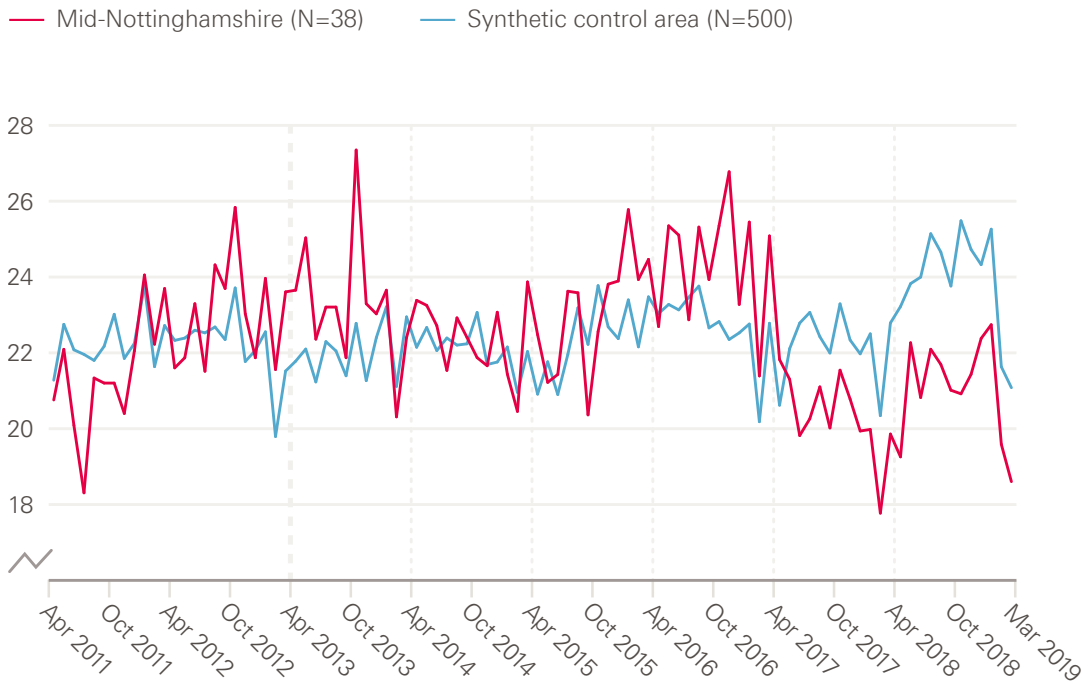
**Figure 3: The impact of the ICTP on emergency admissions. Red lines show observed values for the Mid-Nottinghamshire population and blue lines show estimated values for the synthetic control area.\***

A. Rate of emergency admissions for all causes (number per month per 10,000 people aged >18 years)

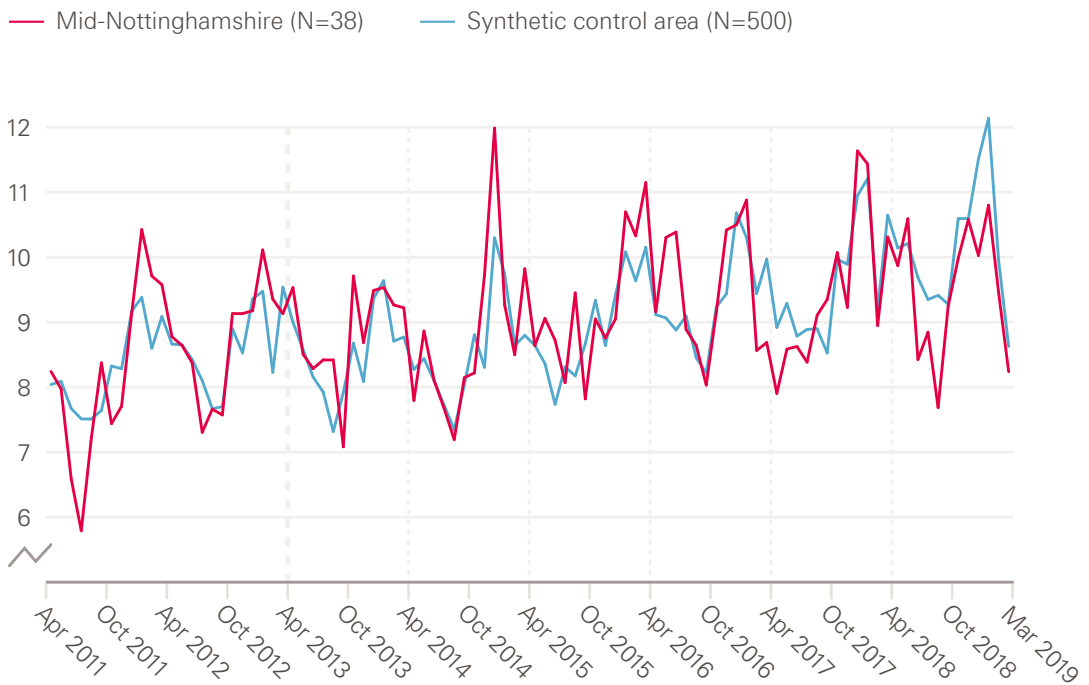


\* Note: Dashed grey line indicates the start of the intervention period. Dotted lines indicate financial years for which we report estimates of impact.

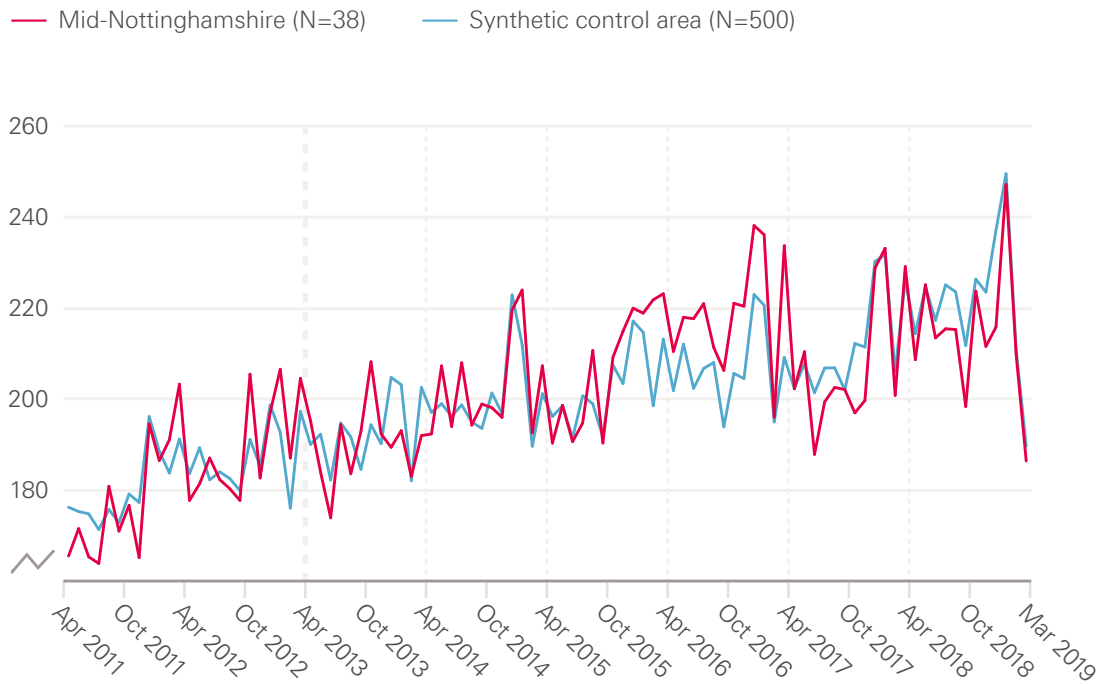
B. Rate of emergency admissions for urgent care sensitive conditions (number per month per 10,000 people aged >18 years)



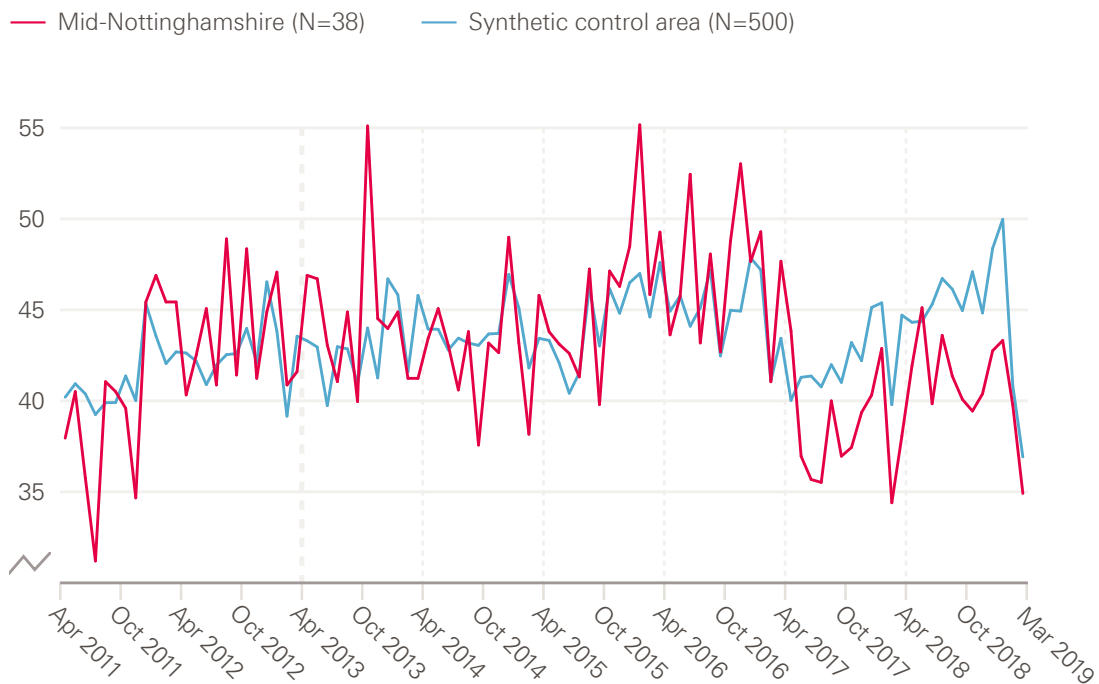
C. Rate of emergency admissions for chronic ACSCs (number per month per 10,000 people aged >18 years)



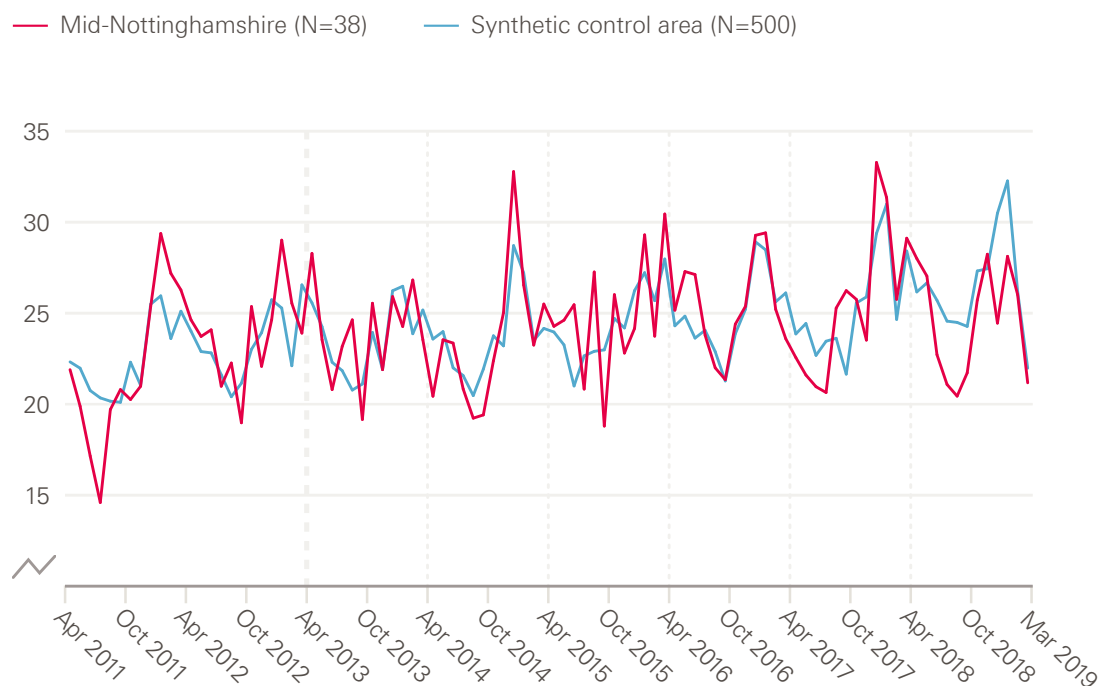
D. Rate of emergency admissions for all causes (number per month per 10,000 people aged >65 years)



E. Rate of emergency admissions for urgent care sensitive conditions (number per month per 10,000 people aged >65 years)



F. Rate of emergency admissions for chronic ACSCs (number per month per 10,000 people aged >65 years)



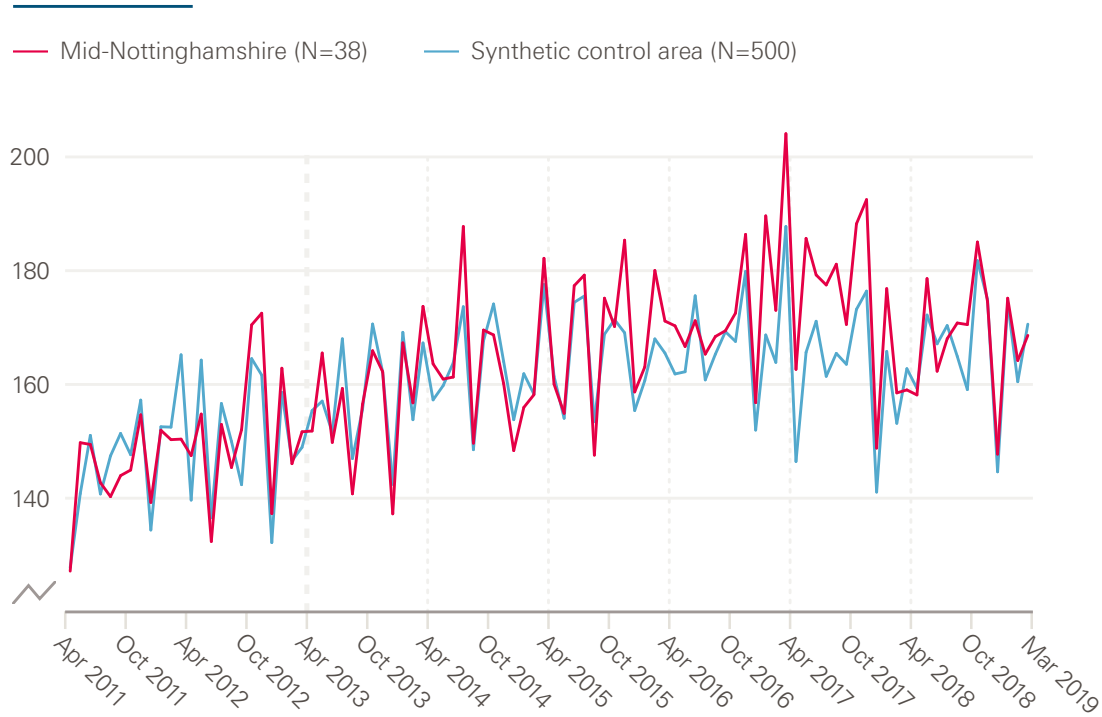
There were no significant differences in the rate of emergency admissions for all causes in Mid-Nottinghamshire compared to the synthetic control area in the first 3 years of the study. After that rates were 4.0 higher in 2016/17, 4.0 (RD: 4.0%,  $p=0.05$ ), 5.4 lower in 2017/18 (RD: 5.4%,  $p<0.001$ ) and 6.7 lower in 2018/19 (RD: 6.4%,  $p<0.001$ ) per 10,000 people per month (Figure 3A, Table 2). Approximately 30–40% of the fewer emergency admissions from April 2017 onwards are attributable to fewer admissions for urgent care sensitive conditions (Figure 3B, Table 2), the remainder being attributable to fewer admissions for non-avoidable (ie not for urgent care sensitive conditions or chronic ACSCs) conditions (not shown). There were no significant differences in the rate of emergency admissions for chronic ACSCs in Mid-Nottinghamshire compared to the synthetic control area during the study period (Figure 3C, Table 2).

Patients aged over 65 years only saw the increase in rates of emergency admissions for all causes compared to the synthetic control area in the third year of the study (2016/17) when rates were 12.3 higher (RD: 5.9%,  $p<0.001$ ) per 10,000 people per month; otherwise there were no significant differences (Figure 3D, Table 3). There were also no significant differences in the rates of emergency admission for chronic ACSCs (Figure 3F, Table 3) and non-avoidable emergency admissions (not shown) in the over 65s in Mid-Nottinghamshire compared to the synthetic control area over the whole study period. However, rates of emergency admissions for urgent care sensitive conditions in the over 65s were 3.8 lower in 2017/18 (RD: 9.0%,  $p=0.01$ ) and 3.95 lower in 2018/19 (RD: 8.8%,  $p=0.02$ ) per 10,000 people per month in Mid-Nottinghamshire than the synthetic control area (Figure 3E, Table 3).

*Mid-Nottinghamshire patients had higher rates of elective admissions between April 2016 and March 2018 than the synthetic control area*

**Figure 4: The impact of the ICTP on elective admissions and outpatient attendances. Red lines show observed values for the Mid-Nottinghamshire population and blue lines show estimated values for the synthetic control area.<sup>\*†</sup>**

A. Rate of elective admissions for all causes (number per month per 10,000 people aged >18 years)

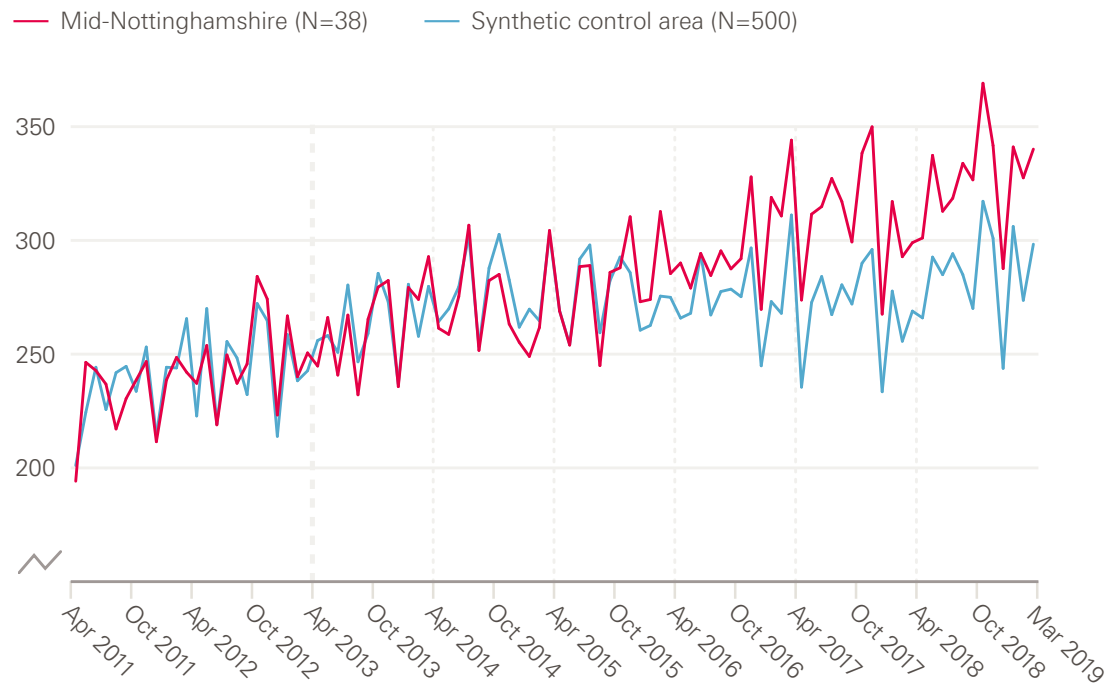


\* In this evaluation we only considered the first attendance or contact relating to a series of outpatient appointments. All subsequent outpatient appointments are treated as follow-up.

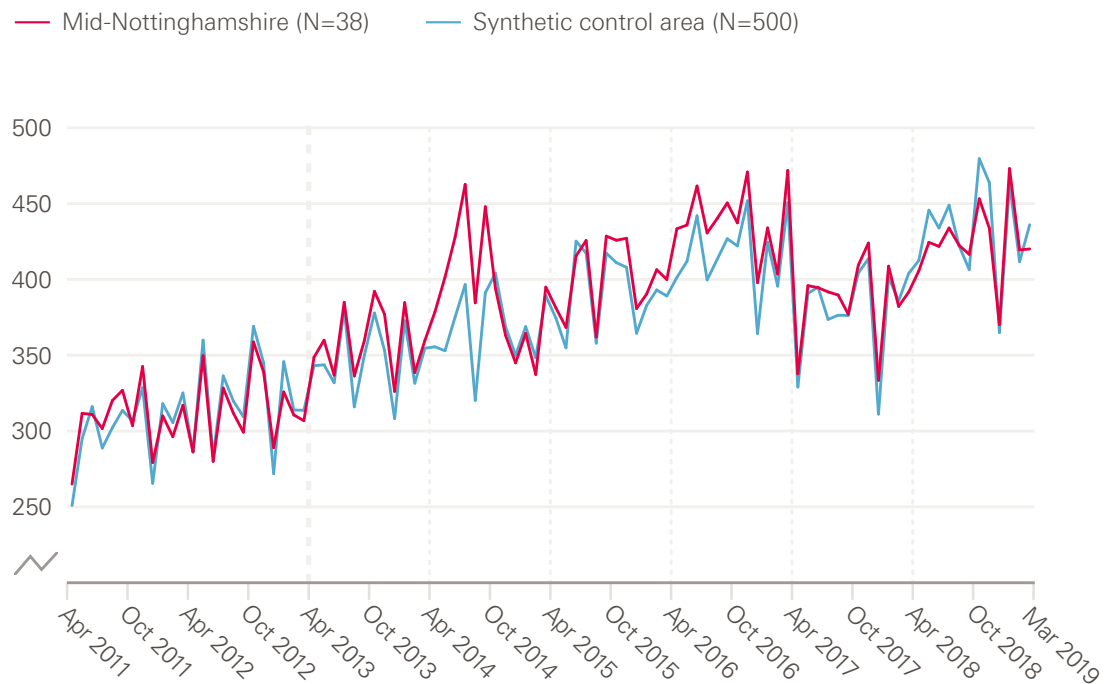
† Note: Dashed grey line indicates the start of the intervention period. Dotted lines indicate financial years for which we report estimates of impact.



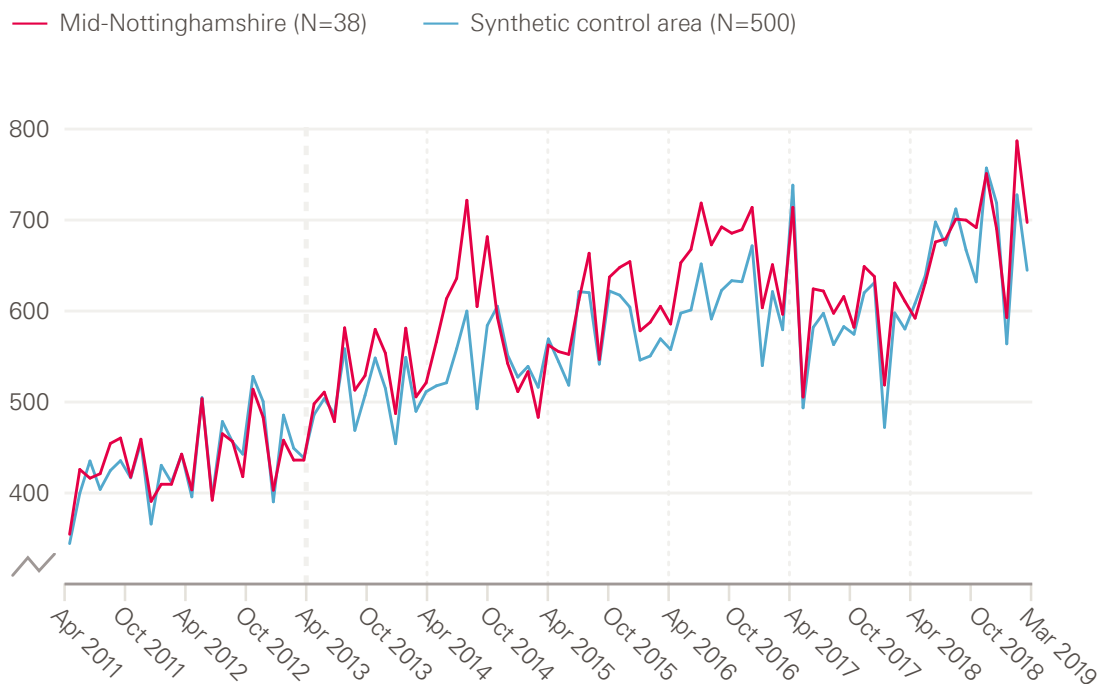
B. Rate of elective admissions for all causes (number per month per 10,000 people aged >65 years)



C. Rate of 1st outpatient appointment (number per month per 10,000 people aged >18 years)



#### D. Rate of 1st outpatient appointment (number per month per 10,000 people aged >65 years)



Between April 2011 and April 2013, the rate of elective admissions in the adult population averaged at approximately 150 admissions per 10,000 per month (Table 2, Figure 4A). After the ICTP started in April 2013, there were no significant differences in the rate of elective admissions in Mid-Nottinghamshire compared to the synthetic control area until approximately April 2016 when rates in Mid-Nottinghamshire were 6.6 higher in 2016/17 (RD: 3.9%,  $p=0.01$ ) and 11.2 higher in 2017/18 (RD: 6.9%,  $p<0.001$ ) per 10,000 per month. No significant differences were observed in the last year of the study.

However, for the over 65s, elective admissions were 22.8 higher in 2016/17 (RD: 8.2%,  $p<0.001$ ), 39.6 higher in 2017/18 (RD: 14.7%,  $p<0.001$ ) and 42.1 higher in 2018/19 (RD: 14.7%,  $p<0.001$ ) per 10,000 per month in Mid-Nottinghamshire than the synthetic control area (Figure 4B, Table 3). The size of these impacts compared to the size of the impacts in the adult population suggest that the over 65s account for most of the increase in elective admissions between April 2016 and March 2018.

#### *Mid-Nottinghamshire patients had higher rates of outpatient appointments for the first 4 years than the synthetic control area*

The rate of outpatient appointments\* was higher in Mid-Nottinghamshire compared to the synthetic control area until the last 2 years of the study: the rates were 11.8 higher in 2013/14 (RD: 3.4%,  $p=0.004$ ), 23.4 higher in 2014/15 (RD: 6.4%,  $p<0.001$ ), and 22.0 higher in 2016/17 (RD: 5.3%,  $p=0.004$ ) per 10,000 people per month (Figure 4C, Table 2). No significant differences were observed in the rate of outpatient appointments between Mid-Nottinghamshire and the synthetic control area in 2017/18 and 2018/19. Trends were similar in the over 65s in Mid-Nottinghamshire compared to the synthetic

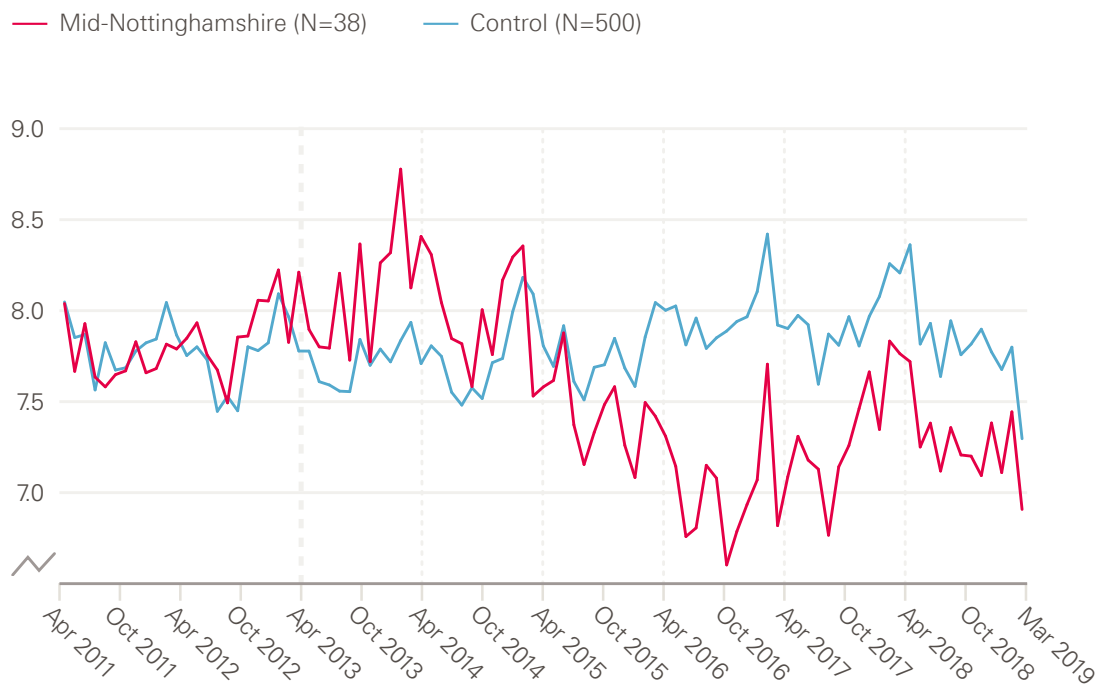
\* In this evaluation we only considered the first attendance or contact relating to a series of outpatient appointments. All subsequent outpatient appointments are treated as follow-up.

control area (Table 3, Figure 4D). Assuming, as previously, that this cohort represent 25% of the adult population 19, then approximately 42–55% of the additional appointments in the adult population can be attributed to those over 65 years.

*Mid-Nottinghamshire patients had lower lengths of stay for emergency and elective admissions than the synthetic control area after 2 years*

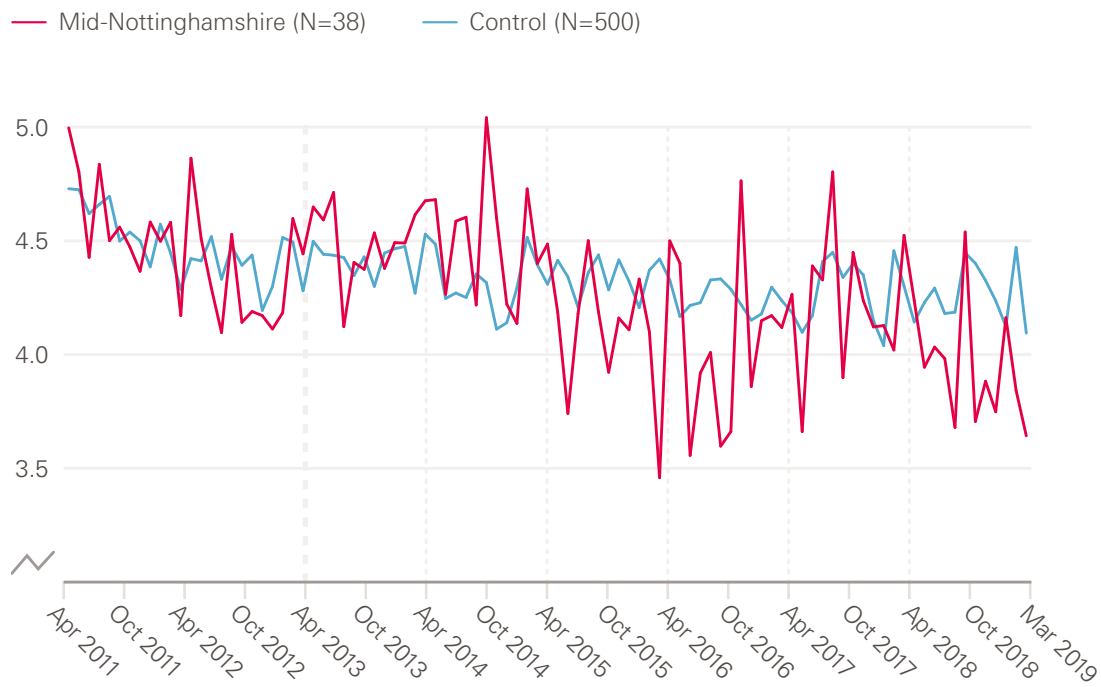
**Figure 5: The impact of the ICTP on length of stay and emergency readmissions. Red lines show values for the population of the Mid-Nottinghamshire vanguard region, and blue lines the estimated counterfactual.\***

A. Average length of stay for overnight emergency admissions (days for people aged >18 years)

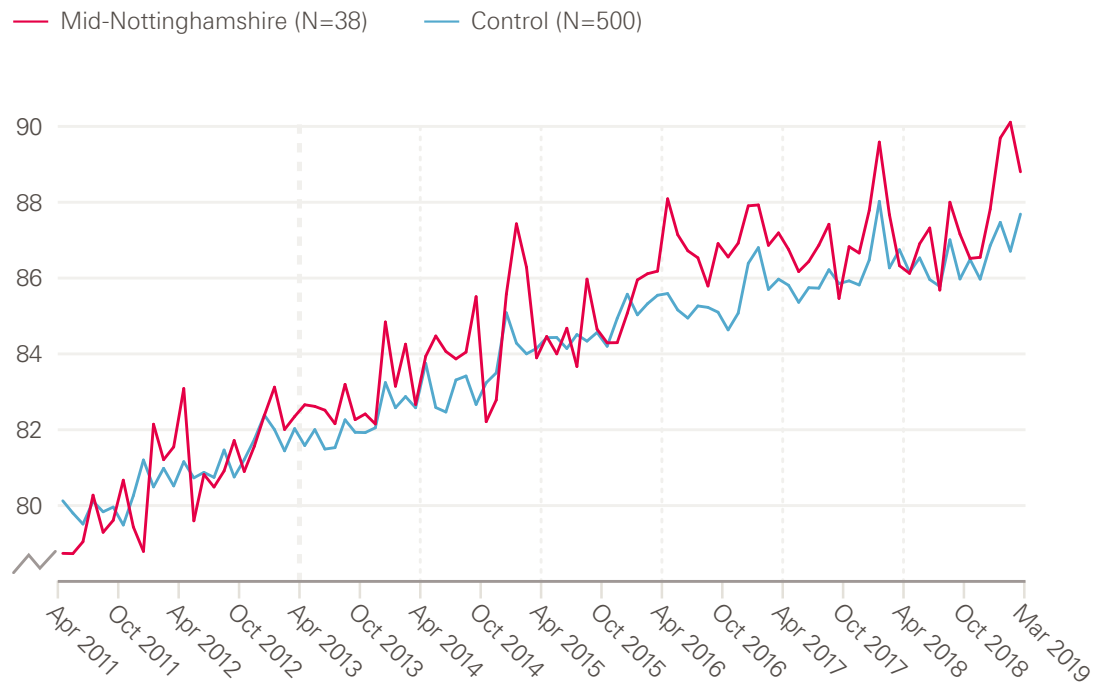


\* An overnight admission refers to an inpatient admission where the patient is admitted for at least 1 day. This excludes admissions for less than 1 day where a patient is admitted and discharged during the same day.

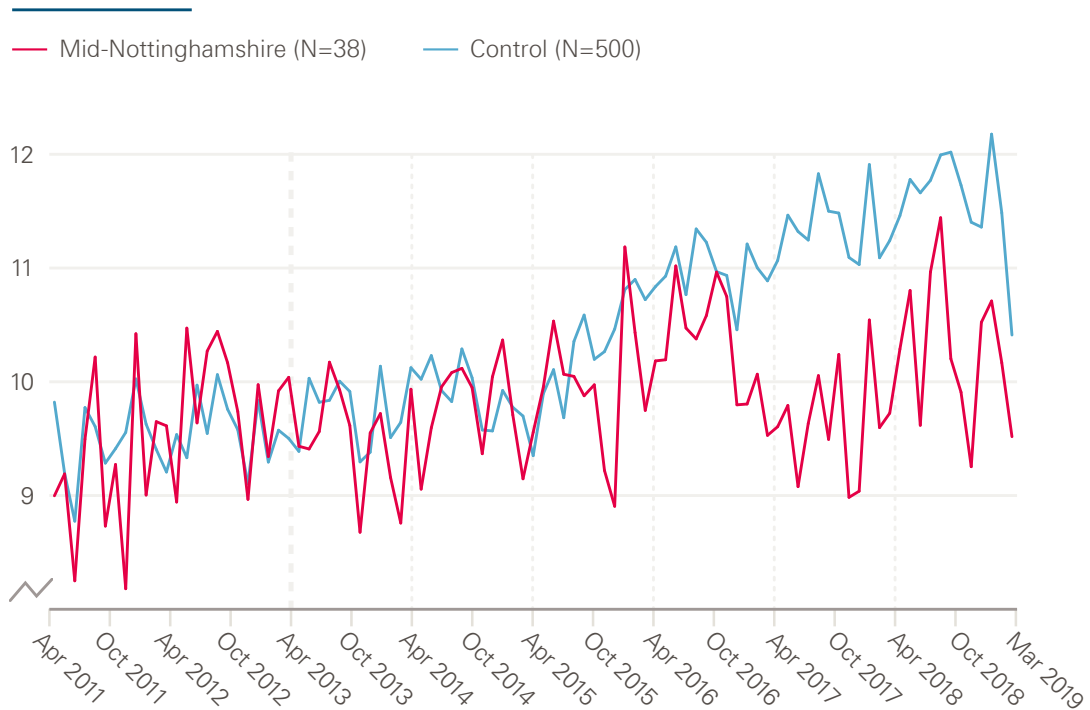
### B. Average length of stay for overnight elective admissions (days for people aged >18 years)



### C. Proportion of elective admissions with length of stay less than 1 day (% of people aged >18 years)



#### D. Rate of emergency admissions (number per month per 10,000 people aged >18 years)



The average length of stay (LOS) for an overnight emergency admission\* was marginally higher for patients in Mid-Nottinghamshire than the synthetic control area in the first 2 years of the ICTP (2013/14 and 2014/15) (Figure 5A, Table 2). However, from 2015/16 onwards, lengths of stay in Mid-Nottinghamshire were shorter, by an average of 0.3 days in 2015/6 (RD: 4.5%,  $p<0.001$ ), 1.0 days in 2016/7 (RD: 12.2%,  $p<0.001$ ), 0.6 days in 2017/18 (RD: 7.6%,  $p<0.001$ ) and 0.5 days in 2018/19 (RD: 7.0%,  $p<0.001$ ).

Similar trends were observed for average LOS for overnight elective admissions in the adult population of Mid-Nottinghamshire (Table 2, Figure 5B), but rates are erratic, with significant impacts observed in some years but not others and estimates of effect that are slightly smaller than that observed for LOS for overnight emergency admissions. The proportion of elective admissions with a zero LOS was consistently 1–2% higher (RD: 1–1.6%,  $p<0.001$ ) in the Mid-Nottinghamshire adult population than the synthetic control area from April 2016 onwards (Table 2, Figure 5C).

#### *Mid-Nottinghamshire patients also had lower rates of emergency readmissions than the synthetic control area after 2 years*

From 2015 onwards there were fewer 30-day emergency readmissions in Mid-Nottinghamshire than the synthetic control area. There were 0.4 fewer emergency readmissions per 10,000 people per month in 2015/16 (RD: 3.8%,  $p=0.04$ ); 0.7 fewer in 2016/7 (RD: 6.7%,  $p<0.001$ ), 1.7 fewer in 2017/8 (RD: 14.8%,  $p<0.001$ ) and 1.4 fewer in 2018/19 (RD: 12.4%,  $p<0.001$ ) (Figure 5D, Table 2).

\* An overnight admission refers to an inpatient admission where the patient is admitted for at least 1 day. This excludes zero length of stay admissions where the patient is admitted and discharged during the same day.

## Interpretation of the findings

It is hard to be sure about what caused the differences seen given the range of different interventions that were implemented. We have seen that there are differences in the impact metrics between Mid-Nottinghamshire and the synthetic control area but what caused them? In this section we outline a few possible explanations.

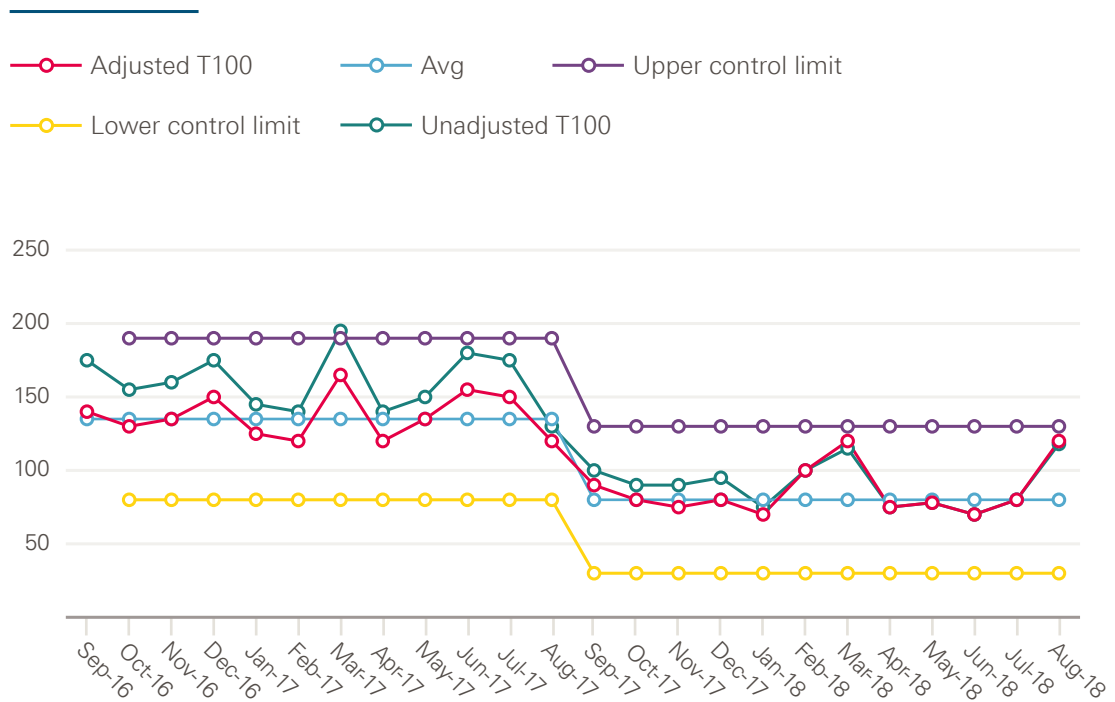
### A&E visits

There was an initial increase in A&E visits by patients aged over 65 years in Mid-Nottinghamshire compared with the synthetic control area in 2013/14 as the LICT was introduced in the N&S region. The increase was compounded further in 2014/15 as the LICT was introduced in M&A CCG. It may be reasonable to conclude that the work of the LICT teams, which aimed to provide focused support for patients at high risk of future hospital admission – approximately two-thirds of whom are expected to be over 65<sup>14</sup> – may have initially identified unmet need leading to increased attendance at urgent care services such as walk-in centres and minor injury units (included here in our impact metric for A&E attendances). Schemes such as the proactive care home – providing proactive and integrated case management of patients within a care home setting – which was only fully rolled out in 2017/18, may have contributed to why the rate of A&E visits for this age group settled down later in the study period.

Towards the end of the study period in April 2017 we saw lower rates of A&E in Mid-Nottinghamshire than the synthetic control area. From our data it is hard to be sure what caused these but the timing of these lower rates broadly correlates with the maturity of services aimed at the entire population which may have become more effective at reducing A&E use over time: such as Intensive Home Support in Newark and Sherwood, the ‘single front door’, the acute home visiting service, and Call for Care. Mid-Nottinghamshire also increased their focus on high-volume users in 2017 with the introduction of a multidisciplinary team to review the ‘Top 100’ cohort of highest users of A&E. Since then, a specialist high intensity user nurse regularly identifies cohorts of patients with high attendance and ensures care plans are in place. Performance is tracked and reported monthly and early analysis indicates fewer attendances by the first cohort from August 2017 onwards (Figure 6).

**Figure 6: Attendances at King's Mill hospital (KMH), NHS Sherwood Forest Hospitals NHS Foundation Trust. Source: Vanguard.**

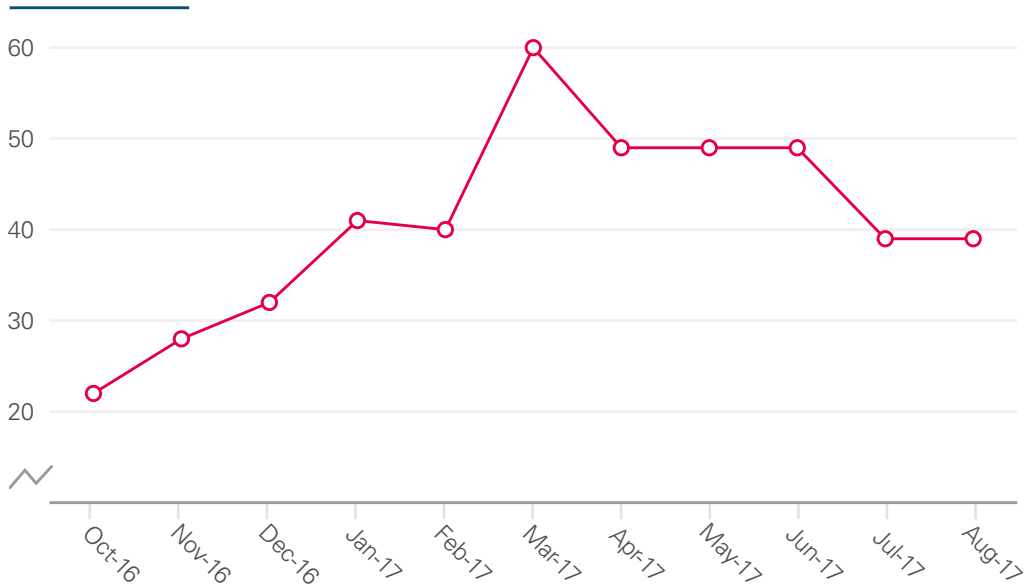
Number of attendances by month at KMH by 'Top 100' (Identified in Sept '16 – Aug '17)



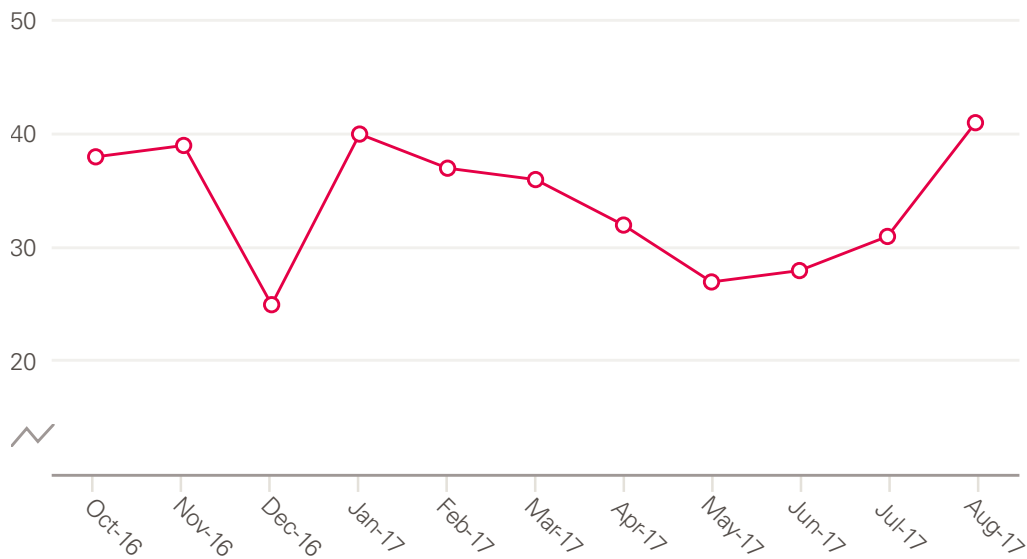
**Emergency admissions and readmissions**

**Figure 7: Referrals accepted into the: (A) Call for Care Rapid Intervention team October 2016 – August 2017; (B) the Intensive Home Support service October 2016 – August 2017. Source: Vanguard.**

A. Number of referrals into the Call for Care Rapid Intervention team



## B. Number of referrals into the Intensive Home Support Service



Lower rates of emergency admissions for urgent care sensitive conditions in Mid-Nottinghamshire compared to the synthetic control area between April 2017 and March 2019 may be directly attributable to the new streaming protocols designed to divert patients from the ambulatory and emergency care unit to primary care and community services. More generally, the lower rates of emergency admissions for all causes in Mid-Nottinghamshire compared to the synthetic control area during this period may be a result of increases in referrals from A&E to the Crisis Resolution and Home Treatment team from mid-2017 until mid-2018 (see Figure 7A), with steady increases in referrals from Rapid Response Liaison Psychiatry teams from early 2017 (see Figure 7B) onwards and the introduction of an acute home visiting service from April 2017.

Trends of lower rates of 30-day emergency readmission from April 2015 onwards, and emergency admissions for urgent care sensitive conditions and non-avoidable conditions from April 2017 onwards, may be attributable to several demand management interventions. These include Call for Care, the clinical navigation service that saw increased activity after it was rolled out to EMAS in 2015 and became truly embedded in October 2016 onwards, with referrals peaking at 60 per month in March 2017; responsive community interventions such as the LICTs and Intensive Home Support which were becoming established and working effectively with a high number of service users; and respiratory services and domiciliary services to administer IV medication, all of which experienced increased demand for services.<sup>11</sup>



Given that adults with chronic medical conditions are more likely to report unmet health care needs,<sup>20</sup> the lack of any evidence of a significant impact of the ICTP on emergency admissions for chronic ACSCs throughout the study may provide support for the theory that the work of the LICT initially uncovered unmet need.

### **Elective admissions and outpatient appointments**

From April 2016 onwards, elective admissions were higher in Mid-Nottinghamshire relative to the synthetic control area, largely driven by more activity in the older population. This trend may reflect a number of different phenomena including a greater awareness of unmet need among GPs and higher levels of patient expectation as a result of the programme of elective care and other ICTP interventions.

Over the first 4 years of the ICTP, rates of outpatient appointments were higher in Mid-Nottinghamshire than the synthetic control area. A large proportion of these additional appointments were attributable to the over 65s. It is possible that the LICT teams, which assign individual packages of care to selected patients, may have initially triggered unmet need in this older cohort resulting in a higher rate of referrals. The programme of elective care focused on providing respiratory, musculoskeletal and ophthalmology community services is likely to have been associated with easing pressures on outpatient appointments from April 2017 onwards.

### **Length of stay**

Shorter lengths of stay for overnight admissions in Mid-Nottinghamshire compared to the synthetic control area from April 2015 onwards might be attributable to an investment in community services that has allowed earlier discharges from the local acute trust. In particular, the shorter lengths of overnight stay are correlated with the roll-out of Intensive Home Support, which was introduced in the Mansfield and Ashfield regions in September 2015 and the Newark and Sherwood regions in January 2018. Intensive Home Support, as part of the LICT, is specifically aimed at reducing length of stay by providing rehabilitation, medical monitoring and nursing care for patients being discharged from hospital. Between October 2016 and August 2017, the vanguard reported that the service had accepted 390 referrals with patients staying on average 24.4 days (Figure 7B); and that 216 patients had their length of stay in hospital reduced through system discharge navigation in 2016/17.<sup>11</sup>

Other explanations for shorter lengths of stay for overnight admissions may include the impact of a review by NHS Sherwood Forest Hospital Trust in April 2015. This looked at workflow in general and included tracking for patients with a length of stay greater than 28 days.<sup>11</sup> The review resulted in the closure of approximately 48 beds.

### **Strengths and limitations**

The synthetic control area is intended to provide an estimate of the hospital use that would have been expected in the Mid-Nottinghamshire population in the absence of the ICTP. However, it is possible that the synthetic control area did not capture hospital activity in Mid-Nottinghamshire before the ICTP started, or how it might have evolved in the absence of the ICTP. If this was the case, then our findings might be due to systematic

differences between Mid-Nottinghamshire and the synthetic control area, rather than changes in how care was delivered. In the absence of a randomised controlled trial, it is not feasible to eliminate this risk, but the study was designed to reduce it as much as possible through the following:

- The synthetic control area was created using data from GP practices with similar characteristics to the GP practices in Mid-Nottinghamshire. However, there were still some differences between the characteristics of the synthetic control area and Mid-Nottinghamshire.\* It was not possible to assess how similar the areas were in characteristics that were not recorded in the data, such as the quality of social care.
- The analysis implicitly weighted the contribution of the donor pool GP practices to ensure the resulting synthetic control area had trends in hospital use that were similar to Mid-Nottinghamshire in the period prior to the introduction of the ICTP. The key assumption is that if the Mid-Nottinghamshire population and the synthetic control area experienced similar rates of hospital use in the 24 months before the changes were made, they would have continued to experience similar rates in the absence of the ICTP. This is a plausible but untestable assumption. We conducted standard tests to check for differences in hospital use between Mid-Nottinghamshire and the synthetic control area for each impact metric. Two impact metrics which failed the test were excluded from further analysis (see Results).
- Since the profile of patients attending hospital might differ between GP practices and change over time, impact metrics were risk adjusted to take account of any differences and make sure that comparisons were made between similar patients. However, we could only adjust for variables that were recorded in the SUS data (eg age, gender, health conditions and prior hospital use), or in publicly available data (eg GP practice disease prevalence, achievement scores, deprivation, etc) and not for variables that were unobserved (such as the clinical severity of health conditions). Therefore, it is still possible that the findings were affected by differences in the characteristics of the patients between the two areas.
- A range of sensitivity analyses were conducted.

As we have acknowledged, there is still uncertainty about which changes to care delivery the findings reflect, whether they are a result of the initiatives associated with the ICTP or of other changes that were made. It is also possible that changes in CCGs outside of the Mid-Nottinghamshire region could have biased estimates, as a proportion of the hospital use by the Mid-Nottinghamshire population occurred at providers elsewhere. Still another possibility is that there were changes within the CCGs to which the GP practices in the control group belong: 59 CCGs participating as new care model vanguards were removed to mitigate this potential bias, but innovation is also happening elsewhere. However, the synthetic control areas were formed from GP practices from many different CCGs and this

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\* For more information see the technical appendix at: [https://www.health.org.uk/sites/default/files/2020-09/TechnicalAppendix\\_NewCareModels.pdf](https://www.health.org.uk/sites/default/files/2020-09/TechnicalAppendix_NewCareModels.pdf)

limits the contribution that any one CCG could make towards the findings. Moreover, it is unlikely that changes to national policy affected the relative difference in impact metrics between the Mid-Nottinghamshire population and the synthetic control area.

The report considered the changes from the perspective of the Mid-Nottinghamshire CCGs and therefore focused on hospital use for people living in the Mid-Nottinghamshire region. However, the Mid-Nottinghamshire CCGs also serve the surrounding area, and there may have been impacts on people living in Nottingham City that were not captured by this analysis. The report has also been restricted to examining impacts on hospital use, due to limitations with the existing data sets. Ideally, future studies would consider the impact on the use of primary and community care, as well as care processes in hospital (such as waiting times for diagnostic tests), clinical outcomes (such as infections), patient outcomes, mortality rates and patient satisfaction. In the absence of these data, care must be taken when interpreting the findings in this report, since shorter lengths of stay or lower admission rates do not always indicate better patient outcomes or lower cost.

There were also limitations in how hospital use was recorded, since it was not possible, for example, to distinguish between admissions to inpatient departments and admissions to ambulatory care units. Payment for admission to ambulatory care is lower than that for admission to inpatient departments, reflecting the lower intensity of the care provided. It is possible that reductions in emergency admissions to inpatient departments were missed if these were disguised by increases in the number of admissions to the ambulatory care units or shifts in the definitions used over time.

## Conclusions

The evaluation analysed the impacts of the Better Together Mid-Nottinghamshire Integrated Care Transformation Programme on hospital use for adults over aged 18 years and registered with a GP practice in the Mid-Nottinghamshire area from April 2013 to March 2019. This long study period allowed us to track impacts that may have embedded over time. We compared the hospital activity of this population with that of a 'synthetic' Mid-Nottinghamshire formed from comparable GP practices elsewhere in England. This synthetic control area was designed to represent a Mid-Nottinghamshire where the ICTP had not been introduced.

Because so many interventions were introduced, it is hard to be sure which interventions caused the change. However, the long-term pattern of impacts observed may be consistent with better management of care in the community, the provision of more responsive, coordinated and streamlined care, and improved access to services – all against a backdrop of rising demand. Services such as Intensive Home Support, acute home visiting, Call for Care and proactive home care are part of a 'home first' approach which may be having a positive impact on the number of A&E visits, emergency admissions and readmissions, and the amount of time people spend in hospital.

The higher rates of A&E visits and outpatient appointments in Mid-Nottinghamshire compared to the synthetic control area in the first few years of the study, particularly in the over 65s, may have been due to the LICTs identifying urgent needs for health care that

might otherwise have remained unmet, or only been identified later. Since adults with chronic medical conditions are more likely to report an unmet health care need,<sup>20</sup> this theory is also supported by the lack of any impact on emergency admissions for chronic ACSCs, despite lower emergency admissions for all other causes. Another explanation is that the LICTs caused patients to be more aware of their health needs, which in turn may have caused patients to visit A&E or request an outpatient appointment. Other studies have also reported that a focus on frail and high risk patients can lead to identification of unmet needs in the short term.<sup>21,22,23,24</sup>

Our evaluation spanning 6 years of the ICTP may provide promising evidence that integrated care programmes have the potential to reduce hospital use over the longer term, even if there are increases in the short term. Previous evaluations of integrated care have only examined impacts on hospital use over shorter periods and have found increased activity. We show that it may take time for new ways of working to become embedded and unmet needs for care may be discovered during initial periods: results here suggest that it took between two and six years before the ICTP was associated with positive impacts on hospital use. Still longer may be required to determine if increased elective activity ultimately leads to better outcomes for patients, and a better understanding of the areas where elective activity increased might be informative. In general, these results emphasise the importance of being realistic about how long it will take to see results and that early assessment of impacts risks erroneous conclusions that may lead policymakers to question or abandon potentially effective initiatives.

Finally, if effects observed here are related to the changes made as part of the ICTP, then future work is required to consider how the different interventions should be aligned, how they interact, and how different patients can be tracked across different care settings. For example, where the focus of interventions is to engage people at higher risk of hospitalisation (LICTs) then this needs to be supported by other interventions that support the care in the community, otherwise there is a risk that activity in the acute setting will increase. Also, for example, what aspects of the combined interventions interacted to reduce emergency admissions in the younger population, and not in the over 65s?

The Mid-Nottinghamshire Better Together ICTP is multifaceted, comprising a complex set of interventions introduced over many years in a large area with different commissioning bodies and a continually changing regulatory environment. This report examines the impact of the programme as a whole on the population of Mid-Nottinghamshire and is not able to determine the individual contribution of each component. Further, we only examine the impact of the ICTP on hospital use. Qualitative data on the underlying mechanisms of the different components, as well as more targeted quantitative evaluation, are needed to gain a more precise understanding of how the different components acted and interacted to produce the impacts observed, and hence the implications for the delivery of health care.

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