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Evaluating integrated care for people with complex needs

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Evaluating integrated care for people with complex needs

Abstract

Objectives
Two integrated care models were introduced in South Somerset for people with complex care needs: the Complex Care Team (CCT) and Enhanced Primary Care (EPC). We assess their impact on a range of utilisation measures, costs and mortality.

Methods
The analysis sample includes 564 CCT and 841 EPC cases who meet specific criteria.
We employ propensity score methods to identify out-of-area control patients. Because the care models and recruitment criteria evolve over time, we perform matching in 6-monthly cohorts and use difference-in-differences analysis to isolate the care models' impact.
We use monthly individual-level linked primary and secondary care data from April 2014 to March 2018 to assess outcomes before and after the introduction of the care models.

Results
We find no evidence of significantly reduced utilisation in any of the CCT or EPC cohorts.
The death rate was significantly lower only for those in the first EPC cohort.

Conclusions
Our analysis is complicated by the personalised care approach and by 'fuzzy' and evolving enrolment criteria. Consequently, the counterfactual may not be well-defined, biasing results toward non-significance.

Key words: integrated care, Vanguard programme, Primary and Acute Care Systems (PACS), propensity score matching, Difference-in-Differences

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Introduction

Improvements in life expectancy[1] are partly due to better and more accessible health care.[2] However, although people are living longer, many are living with one or more long-term condition (LTC). These people typically require a range of ongoing health and social care support. Unless care is integrated, patients may not be cared for in the most appropriate setting or at the right time.

An area facing these demographic and system challenges is South Somerset in the UK: over 20% of the population is aged over 65 and around 4% consume 50% of the healthcare resources.[3] South Somerset has a long history of joint working and integrated care initiatives.[3] As one of the integrated primary and acute care systems (PACSs)[4] in the English national Vanguard programme,[5] two new models of integrated care (IC) were introduced in South Somerset.

The first IC model, the Complex Care Team (CCT), provides senior medical input, care coordination, and a personalised care plan to support self-care. Staffed by GPs with expertise in chronic care management, complex care nurses and other keyworkers, the CCTs aim to prevent avoidable hospitalisations or, for those in hospital, to support appropriate inpatient care.

In February 2015, a single CCT was set up, covering the whole of South Somerset. CCT staff identified complex patients already in hospital to support them there and post-discharge. In August 2016 two additional CCTs were established. GPs could refer their complex patients to the local CCT, but some preferred to continue managing their own patients, with CCT support. This re-structured model became the norm in March 2017, with the three CCTs working with clusters of GP practices to provide a continuum of care.

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The second IC model, Enhanced Primary Care (EPC), supports people with complex conditions to manage their own conditions more effectively, primarily through health coaching, and thereby reduce the need for costly hospital care. Working closely within primary care, EPCs drew upon a wider skill mix, including health coaches, musculoskeletal (MSK) practitioners, pharmacists, and mental health workers.

Individuals with three or more LTCs from a list of eight (cancer, chronic obstructive pulmonary disease, dementia, stroke, cardiac problems, depression, diabetes, chronic kidney disease) and/or a history of frequent admissions were eligible for the CCT. However, these criteria subsequently broadened to include patients' social circumstances (information that is not routinely recorded). EPC was initially targeted at people likely to become the complex patients of the future, usually those with one or more LTC and/or fragility and/or a complex social situation. Gradually, the distinction between the CCT and EPC care models blurred into a care continuum, with EPC also acting as step-down care for patients no longer needing CCT input.[6]

The PACs models are intended to support joint working and so 'reduce reliance on hospital care'.[4] In this paper, we assess the impact of the two IC models ('interventions') on utilisation and mortality.

Data

The study analysed pseudonymised patient-level datasets which cover the entire Somerset population and capture information about each resident´s characteristics, healthcare utilisation, care home residency, and date of death (if applicable). Those enrolled in the CCT or EPC models can be identified, but intervention costs are not reported.

The matching variables are based on monthly data, so the baseline measures used for matching are closely aligned with patients' enrolment date.

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Datasets were accessed as part of a Data Sharing Agreement between the University of York and the NHS South, Central and West Commissioning Support Unit [NHS Digital Reference: NIC-43362-G7T9X].

Methods

Evaluating the impact of these two IC models faced two key challenges.

Firstly, IC interventions and the eligibility criteria evolved over time, to ensure care was patient-centred, and to facilitate ´reflexive learning´.[7] To account for these changes, we divided CCT and EPC enrolees into 6-month cohorts.

Secondly, patients were not randomised to the IC interventions. Propensity score matching techniques can help identify suitable controls and capture the 'counterfactual', namely what would have happened in the absence of the IC intervention. Ideally, controls should resemble cases in all relevant characteristics with the exception that they are not exposed to the IC intervention.

As it was intended that the two care models would be rolled out to all eligible people in South Somerset, matched controls were selected 'out of area', in other parts of Somerset.[8, 9]

Table 1 shows the period covered by each cohort and the period midpoint (columns (2) and (4)). In total, 661 CCT cases and 908 EPC cases had valid or imputed enrolment dates (column (6)). Of those, 564 CCT cases and 841 EPC cases were suitable for matching (column (7)).

Table 1: Overview of the intervention cohorts

6-month cohort	Cohort period	PRE period for DiD†	Cohort midpoint^	POST period for DiD†	Cases with valid or imputed enrolment date	Cases used for matching&
(1)	(2)	(3)	(4)	(5)	(6)	(7)

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CCT1	22 Feb 2015-21 Aug 2015	Apr 2014–Feb 2015	22 May 2015	Sept 2015–July 2016	96	86
CCT2	22 Aug 2015-21 Feb 2016	Sept 2014–Aug 2015	22 Nov 2015	Mar 2016–Feb 2017	53	47
CCT3	22 Feb 2016-21 Aug 2016	Mar 2015–Feb 2016	22 May 2016	Sept 2016–Aug 2017	99	90
CCT4	22 Aug 2016-21 Feb 2017	Sept 2015–Aug 2016	22 Nov 2016	March 2017-Feb 2018	266	209
CCT5	22 Feb 2017-21 Aug 2017	Aug 2016–Feb 2017	22 May 2017	Sept 2017-March 2018	150	132
CCT – total					661	564
EPC1	01 Sep 2016-28 Feb 2017	Sep 2015–Aug 2016	01 Dec 2016	Mar 2017–Feb 2018	662	603
EPC2	01 Mar 2017-30 Aug 2017	Aug 2016–Feb 2017	01 June 2017	Sep 2017–March 2018	246	231
EPC – total					908	841

Notes:

^ matching at this point

† Because data were available from April 2014 to March 2018, the pre-enrolment and post-enrolment periods used for the DiD analysis were shorter than 12 months for cohorts CCT1, CCT5 and EPC2: 11 months for CCT1; (March 2014 not available); and 7 months for CCT5 and EPC2 (April 2018 and onwards not available)

&Numbers differ from previous column due to exclusions. Individuals were excluded if: there was a discrepancy between date of death and date of enrolment; the patient record was incomplete in the pre-enrolment period; matching variables were missing from the monthly datasets (and could not be imputed); intervention cases lived outside of South Somerset; or if individuals were aged < 18.

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Base case analysis

For each 6-month cohort, matching variables capturing patient profiles at baseline are used to derive a 'propensity score' for each individual in Somerset. The score reflects the likelihood of being exposed to the IC model, given a set of individual characteristics. For each cohort, we base the matching variables on the cohort midpoint and generate variables from monthly data. For both CCT and EPC, our matching variables are: age, gender, socio-economic status, a count of 8 LTCs, a count of GP visits in the past 12 months, a count of prescriptions received in the past 12 months, a 'HealthNumerics-RISC score',[10] and care home residency. Derived from demographic, clinical and utilisation data, the RISC score represents the likelihood of inpatient admission over the next 12 months and is calculated each month for everyone living in Somerset. The binary measure of care home residency captures individuals' capacity for independent living and is a proxy for frailty.

The propensity scores used to match cases with controls[11] are estimated for the South Somerset population (where the care models were introduced) using logistic regression and then predicted for the population in the other areas of Somerset (see online Appendix 1).

We employ a simple 'difference in differences' (DiD) regression approach (online Appendix 1) that includes a single IC intervention, and pre- and post-enrolment periods to compare the utilisation of the matched cohorts of cases and controls, having taken account of variations in the characteristics between the groups.

Matched controls may have been exposed to other forms of IC intervention in other parts of Somerset. If so, this would violate the assumption that changes in utilisation for controls reflect only general time trends.[11] Our analysis therefore controls for the Somerset Practice Quality Scheme (SPQS), which was introduced in 2014 to encourage multi-disciplinary working in general practice.[12]

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Sensitivity analyses

There are two reasons why cases and controls may not be well-matched. First, there is considerable variation among cases in terms of complexity, diagnosis, and care needs. If those enrolled were close to death, and died between enrolment and follow up, they were no longer at risk of an 'event' such as a hospital admission. Including the zero or low utilisation of those who died reduces the mean value in their group. In recognition of this potential bias, we perform a robustness check in the form a DiD for the subgroup of survivors (only) by matching survivors in the intervention group to comparable (surviving) controls.

Second, some patients may have been exposed to both IC models. To account for the possibility of crossover, we test the impact of prior use of CCT in a sensitivity analysis.

All analyses were conducted in Stata version 14.

Service utilisation measures

The analysis tests for the effect of CCT and EPC on a range of service utilisation measures, all based on monthly values. For CCT, there are five measures: outpatient visits, accident and emergency (A&E) attendances, emergency admissions, bed days, and the total cost of primary, community and hospital care. For EPC, there are three measures: acute inpatient admissions, acute outpatient admissions, and the costs of primary care and community care as a proportion of total cost.

Figure 1 and Figure 2 show trends in utilisation for CCT and EPC respectively, with the vertical lines and shading indicating the evaluation periods. In Figure 1, all utilisation measures are shown on a scale of 0 to 1, except for beddays (0 to 5) and total monthly costs (£0 to £3000). In Figure 2, acute outpatient visits and acute admissions are shown on a scale of 0 to 0.5 and the proportion of total costs spent on out-of-hospital care is shown on a

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scale of 0 to 1. For the analysis, outcomes are aggregated over the relevant period. For most cohorts, the period is 12 months pre and 12 months post the 6-month window. For the fifth CCT cohort and the second EPC cohort, the periods are each 7 months due to limited availability of follow-up data (Table 1).

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Results

Balance graphs

In all CCT and EPC cohorts, matching worked well in terms of the baseline (midpoint) comparability of cases and controls on the matching variables. Descriptive statistics and balance graphs are in online Appendix 2.

Impact on utilisation

Table 2 reports the impact for the five CCT cohorts in turn, together with a pooled analysis that assesses the overall impact of the CCT intervention. The pooled analysis has the advantage of including all CCT cases and controls, but assumes that cases were exposed to the same form of CCT, ignoring its evolution.

Each difference-in-differences equation contains four key variables that disentangle general temporal changes (*POST*), differences between the control and treatment groups (*IC*), the impact of the care models (*DiD*), and the effect of the SPQS scheme (*SPQS*).

First, utilisation or costs may change over time irrespective of the introduction of the CCT intervention. These general temporal changes are captured by the *POST* variable, which is always negative and often significant. The pooled analysis shows that a significant decline (P<0.001) in utilisation and costs occurred independently of the CCT intervention.

Second, the variable *IC* captures differences in utilisation in the pre-enrolment period between the case and control groups. Such differences may reflect imperfect matching, and the *IC* variables captures and accounts for this possibility. The pooled analysis shows that CCT cases had significantly higher utilisation and costs than controls in the pre-enrolment period. Cases had more outpatient visits in CCT1 (P=0.006) and CCT2 (P=0.013), higher total

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costs in CCT3 (P=0.022), more non-elective admissions in CCT4 (P=0.023) and CCT5 (P=0.011) and more A&E attendances in CCT5 (P=0.011).

Third, the variable *DID* captures the variable of policy interest: the impact of the CCT intervention on utilisation or costs, after accounting for time trends and pre-enrolment differences with the controls. The pooled analysis found no significant impact of the CCT intervention on utilisation but CCT cases had significantly higher costs than the controls (P<0.001). Bed days were significantly higher for cases in CCT1 (P=0.025) and costs were significantly higher for cases in CCT4 (P=0.004).

Fourth, the variable *SPQS* captures the effect of the Somerset Practice Quality Scheme. This scheme had no significant effect on any utilisation measure.

Table 2: DiD results for utilisation: CCT cohorts

	Acute Outpatient visits		A&E attendances		Non-elective admissions		Bed days		Total Cost	
Cohort 1 (N=344)^	Coef	P-val	Coef	P-val	Coef	P-val	Coef	P-val	Coef	P-val
POST	**-2.16**	0.016	-0.72	0.057	**-0.59**	0.028	**-8.34**	0.030	**-5,363**	0.005
IC	**2.54**	0.006	0.56	0.153	0.34	0.218	2.17	0.581	3,393	0.086
DiD	0.04	0.978	0.50	0.349	0.41	0.284	**12.16**	0.025	3,782	0.164
SPQS	0.35	0.703	-0.04	0.925	-0.21	0.431	-1.69	0.661	-429	0.825
Cohort 2 (N=188)^	Coef	P-val	Coef	P-val	Coef	P-val	Coef	P-val	Coef	P-val
POST	-1.26	0.401	-0.51	0.415	-0.62	0.212	-7.11	0.191	-2,912	0.317
IC	**3.87**	0.013	0.84	0.192	0.56	0.268	0.12	0.982	4,005	0.182
DiD	-0.57	0.786	0.23	0.791	1.06	0.129	12.87	0.095	4,128	0.316
SPQS	1.33	0.483	-0.07	0.933	-0.17	0.790	2.02	0.770	4,296	0.246
Cohort 3 (N=360)^	Coef	P-val	Coef	P-val	Coef	P-val	Coef	P-val	Coef	P-val
POST	-1.93	0.133	**-0.93**	0.014	**-0.74**	0.031	**-5.97**	0.037	-3,280	0.093
IC	2.38	0.075	0.36	0.359	0.48	0.181	3.14	0.289	**4,658**	0.022
DiD	2.63	0.148	0.30	0.574	0.37	0.451	2.56	0.526	3,100	0.262
SPQS	1.41	0.326	0.12	0.769	-0.18	0.643	3.27	0.304	1,305	0.549
Cohort 4 (N=836)^	Coef	P-val	Coef	P-val	Coef	P-val	Coef	P-val	Coef	P-val
POST	**-1.25**	0.025	**-0.51**	0.047	**-0.49**	0.010	-3.41	0.080	**-3,312**	0.017
IC	1.08	0.063	0.48	0.074	**0.45**	0.023	3.63	0.073	2,195	0.127
DiD	1.20	0.128	-0.11	0.762	0.06	0.830	1.17	0.670	**5,595**	0.004

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	Acute Outpatient visits		A&E attendances		Non-elective admissions		Bed days		Total Cost	
SPQS	-0.59	0.361	0.00	0.995	-0.23	0.290	1.18	0.604	-1,778	0.269
Cohort 5 (N=528)^	Coef	P-val	Coef	P-val	Coef	P-val	Coef	P-val	Coef	P-val
POST	-1.25	0.086	-0.35	0.273	-0.32	0.154	-4.70	0.060	**-3,156**	0.021
IC	1.13	0.132	**0.83**	0.011	**0.59**	0.011	3.66	0.155	981	0.486
DiD	-0.74	0.471	-0.27	0.555	-0.24	0.442	-2.00	0.571	1,762	0.361
SPQS	0.76	0.401	-0.33	0.399	-0.28	0.309	0.02	0.495	249	0.883
Pooled (N=2,256)^	Coef	P-val	Coef	P-val	Coef	P-val	Coef	P-val	Coef	P-val
POST	**-1.50**	<0.001	**-0.57**	<0.001	**-0.52**	<0.001	**-5.18**	<0.001	**-3550**	<0.001
IC	**1.77**	<0.001	**0.59**	<0.001	**0.48**	<0.001	**3.12**	0.018	**2670**	0.001
DiD	0.65	0.241	0.04	0.853	0.17	0.301	3.30	0.066	**3901**	<0.001
SPQS	0.25	0.584	-0.07	0.714	-0.24	0.083	0.60	0.683	-339	0.709

Note: significant (p<0.05) results in bold. N is the number of observations (4 observations per patient).

^ N is the number of observations used in the regression and equals four times the number of cases in the cohort (see column 7, Table 1): outcomes for cases and matched controls are observed pre-enrolment and post-enrolment.

Table 3 shows the impact of the EPC intervention on utilisation for the two EPC cohorts, and a pooled analysis featuring all EPC cases and controls. In the pooled analysis, the proportion of out-of-hospital costs fell over time (*POST* P<0.001) and, pre-enrolment, cases had more outpatient visits (*IC* P<0.001) and a higher proportion of out-of-hospital costs (*IC* P<0.001) than controls. The non-significant *DiD* coefficients indicate that the EPC intervention had no impact on utilisation or costs. Nor did the *SPQS* arrangements.

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Table 3: DiD results for utilisation: EPC cohorts

	Acute Inpatient		Acute Outpatient		Proportion of out of hospital costs	
Cohort 1 (N=2,412)^	Coef	P-val	Coef	P-val	Coef	P-val
POST	-0.28	0.150	-0.56	0.086	**-1.23**	<0.001
IC	0.26	0.203	**1.32**	<0.001	**1.78**	<0.001
DiD	0.49	0.075	0.62	0.181	0.55	0.068
SPQS	0.06	0.796	0.27	0.467	-0.37	0.134
Cohort 2 (N=924)^	Coef	P-val	Coef	P-val	Coef	P-val
POST	-0.03	0.770	-0.44	0.134	-0.26	0.097
IC	0.03	0.772	0.44	0.154	**0.36**	0.031
DiD	0.02	0.863	0.30	0.462	0.25	0.263
SPQS	0.14	0.154	-0.17	0.590	-0.07	0.674
*Pooled (N=3,336)^*	Coef	P-val	Coef	P-val	Coef	P-val
POST	-0.21	0.145	**-0.53**	0.037	**-0.96**	<0.001
IC	0.19	0.211	**1.05**	<0.001	**1.34**	<0.001
DiD	0.36	0.076	0.53	0.138	0.47	0.082
SPQS	0.11	0.516	0.20	0.475	-0.10	0.657

Note: significant (p<0.05) results in bold. N is the number of observations (4 observations per patient).
^ N is the number of observations used in the regression and equals four times the number of cases in the cohort (see column 7, Table 1): outcomes for cases and matched controls are observed pre-enrolment and post-enrolment.

Impact on mortality

Mortality results from the DiD for the CCT and EPC models are in Table 4. The only significant differences are for CCT5, where the mortality rate of cases is higher (P=0.002), and for EPC1 where the mortality rate of cases is lower (P=0.003).

Table 4: DiD results for mortality: CCT and EPC cohorts

Cohort	CCT 1 (N=344)	CCT 2 (N=188)	CCT 3 (N=360)	CCT 4 (N=836)	CCT 5 (N=528)	Pooled (N=2,256)
POST	**0.26**	**0.17**	**0.21**	**0.19**	**0.13**	**0.19**
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
IC	0.01	-0.01	-0.02	-0.005	0.01	-0.00
	(0.883)	(0.885)	(0.620)	(0.863)	(0.736)	(0.99)
DiD	0.12	-0.11	-0.09	-0.01	**0.15**	0.03
	(0.101)	(0.110)	(0.109)	(0.800)	(0.002)	(0.26)
SPQS	-0.03	0.04	0.08	0.02	-0.06	0.00
	(0.520)	(0.540)	(0.060)	(0.528)	(0.171)	(0.99)
Cohort	EPC1 (N=2,412)	EPC2 (N=924)	Pooled (N=3,336)			

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POST	**0.09**	**0.03**	**0.08**
	(<0.001)	(0.026)	(<0.001)
IC	-0.01	-0.01	-0.01
	(0.620)	(0.640)	(0.491)
DiD	**-0.04**	0.01	**-0.03**
	(0.003)	(0.432)	(0.014)
SPQS	0.02	0.02	**0.02**
	(0.082)	(0.139)	(0.019)

Note: P-values in parentheses; significant (p<0.05) results in bold; N is the number of observations (4 observations per patient).

Sensitivity analyses

There is considerable variation in death rates across cohorts and between cases and matched controls (see online Appendix 3, Table A3.1, and Figures A3.1 and A3.2).

In general, the analysis of the subgroup of survivors supported findings from the main analyses (online Appendix 3, Tables A3.2-A3.4).

Table A3.5 in the online Appendix 3 shows the results when prior use of CCT on EPC patients was taken into account. In the EPC1 cohort, there were three significant differences. For the subgroup of cases that used both CCT and EPC (captured by the variable DiD-dual), acute inpatient use was higher (P=0.002) and the proportion of out-of-hospital costs was lower (P=0.017) compared with controls. The remaining EPC patients (captured by the DiD variable) had a significantly higher proportion of out-of-hospital costs (P=0.001) than controls. There was no effect of prior CCT use on utilisation in EPC2 cohort.

Discussion

Establishing the impact of IC models is challenging if the intervention is not subject to a randomised controlled trial. Challenges also arise because the nature, purpose and target population of the IC intervention are difficult to define and evolve over time.[13]

To tackle these challenges, we use propensity score matching to identify out-of-area controls and we divide enrolees into 6-monthly cohorts in recognition of the evolving nature

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of the care models and changes in the characteristics of enrolees. We employ difference-in-differences analysis to capture the impact of the intervention and to account for time trends.

We find no robust evidence that either intervention significantly reduced utilisation during the 12-month follow-up period; rather, cases had significantly more beddays in CCT1, and costs were higher in CCT4 compared with controls. There was no conclusive evidence that the care models had an impact on mortality. International reviews of integrated care support our findings, with limited evidence of impacts on utilisation or costs.[14 15]

These findings should be interpreted with caution. First, there are concerns about the comparability of cases and controls. Differences in death rates across controls and cases may reflect systematic unobserved differences in severity. Consequently, our findings may under-estimate the true impact of the care models. Second, this evaluation is of evolving care models during their developmental stages and follow up was limited to 12 months. Third, emerging circumstantial evidence indicates that the programme of integrated care initiatives in South Somerset may now be having an impact on non-elective inpatient admissions and, as a consequence, the hospital has closed 18 beds.[16] Nonetheless, our findings do not validate the logic underpinning the new care models, namely that integrating care reduces hospital utilisation.

Conclusion

Our analysis found no robust evidence that either IC intervention significantly reduced utilisation over the 12-month follow-up period, and no consistent evidence that the care models had an impact on mortality. However, this was not an effectiveness study of fully-fledged integrated models of care. Future research should test longer-term outcomes

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associated with the new models of care and quantify their contribution in the context of broader initiatives.

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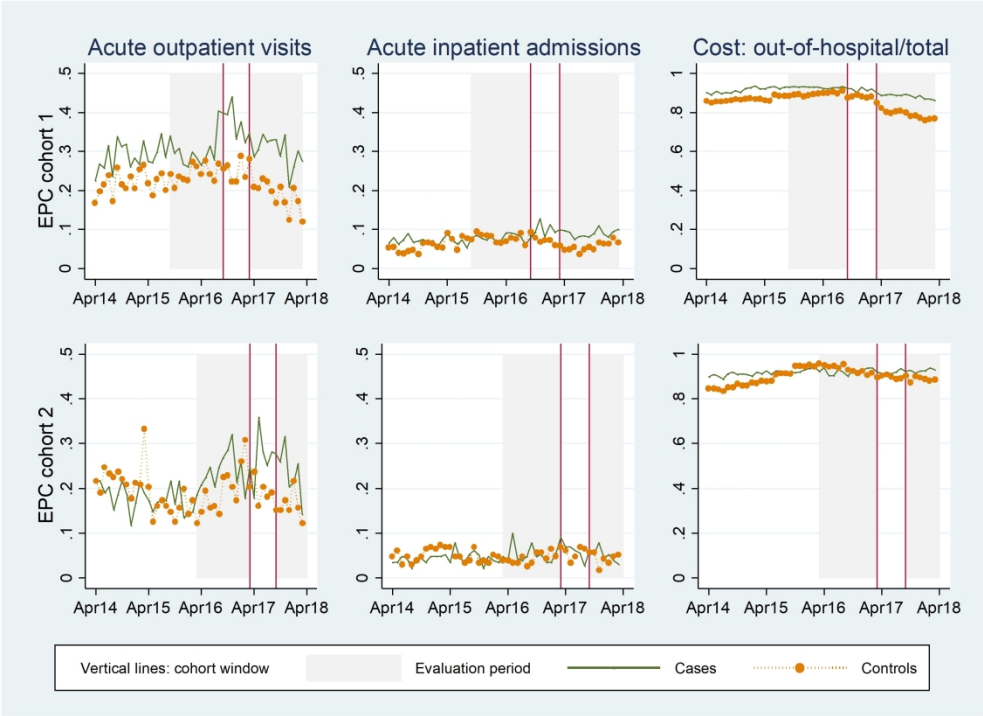
Under Review

Trends in utilisation for CCT cases and controls: mean monthly utilisation

890x649mm (96 x 96 DPI)



Trends in utilisation for EPC cases and controls: mean monthly utilisation

890x649mm (96 x 96 DPI)