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*Research Article*

# The Relationship between the Prevalence of the Urgent and Emergency Care Vanguard Participance and Delayed Transfers of Care in English Local Authorities

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This paper examines the relationship between the prevalence of the urgent and emergency care vanguard (UEC) at the local authority level and their delayed transfers of care (DTOC) rates in England. We created a novel measure of exposure to UEC vanguards based on the residence of patients who used UEC partner hospitals, and we group it by the level of exposure (high, medium, low, none). We use this measure to estimate the effect of UEC vanguards on DTOC rates and then on DTOC rates by sector and a range of reasons associated with the delay. The analysis was run at the local authority level (LA) using quarterly data from NHS England for 150 English LAs from the years 2012–2017. We find a statistically significant UEC exposure effect of around 0.3% reduction in total DTOC to a 1% increase of UEC exposure (equivalent to 775 DTOC days per local authority per quarter in high UEC exposure areas), a result robust to various specification checks. Nonacute sector DTOC was found to be more responsive to UEC vanguards in comparison to acute sector DTOC (0.4% and 0.3% reductions, respectively, to every 1% of UEC exposure). DTOC due to social care was particularly responsive to UEC exposure (0.7% reduction to 1% exposure). DTOC reasons associated with the highest impact of UEC exposure were as follows: awaiting a care package at own home, waiting for further NHS nonacute care, and completion of assessment (reductions of 0.5%, 0.3%, and 0.3% to 1% exposure, respectively). All three reasons were originally associated with the largest number of DTOC days. These findings further advocate for UEC vanguards having been successful at alleviating the pressure on hospitals related to DTOC.

## 1. Introduction

Currently, the UK is facing unprecedented challenges in terms of caring for an aging population, alongside continued austerity measures. By 2041, it is estimated 26% of the total population (20.4 million UK residents) will be aged 65 years and over [1]. In 2019-20, the age group with the highest number of hospital episodes was patients aged 70 to 74 (1.9 million) [2]. Delays with transferring patients out of the hospital (DTOC) when they are medically fit to be discharged adds to the financial burden. The national audit office has previously estimated that delayed transfers of care cost £820 million each year for the population aged 65 and over [3]. There is also a social care impact as DTOC has been found to be associated with reductions in patients' mobility and their daily activities, infections, mortality, and depression [4]. In February 2020, the most common reason for DTOC was people awaiting a care package in their own homes. The second most common reason was people awaiting further nonacute NHS care, followed by people awaiting a nursing home placement [5].

The integration of care is often perceived as a solution to financial challenges, with integrated care continuing to be a central theme within health and social care policy in England. The NHS Long Term Plan [6] outlined that the NHS and partners should have moved to creating integrated care systems by April 2021. It is anticipated that by April (2022) there will be new statutory integrated care system arrangements in place [7]. Since 2018, integrated care systems have enabled NHS organizations, local authorities, and frontline professionals to join forces to plan and provide around residents' needs [8].

A number of integration programmes have been implemented with a focus on providing a mechanism for the care sector to work together and integrate services for individuals requiring support. The Better Care Fund (BCF) initiative and the New Models of Care (vanguard) programme had a DTOC focus. The BCF policy framework was introduced as a new approach to the national funding of services for people. The BCF is a funding mechanism to promote and facilitate joint working between the health and social care sectors. Forder et al. [9] found that DTOC (delayed days) rates per head were negatively related to BCF expenditure per person. For a 1% increase in BCF expenditure per capita (from the mean value of £145 per capita 65+ per quarter), the central estimates indicated that this would result in a 0.073% reduction in delays (the incremental or marginal change). The estimated *total* effect of BCF expenditure (i.e., comparing what is currently spent from what might have happened if there had been zero BCF expenditure) on delayed days was a reduction of 9.3% [9].

The New Models of Care initiative was specified in the "Five Year Forward View," with the aim to remove the barriers between community, primary, and acute health care [10]. In January 2015, the NHS invited individual organizations and partnerships to apply to become 'vanguards' for the new care models programme [11]. There are five vanguard types [12]:

(i) Integrated primary and acute care systems, joining up GP, hospitals, community, and mental health services.

(ii) Multispecialty community providers, moving specialist care into the community from hospitals.

(iii) Enhanced health in care homes, improving and integrating health, care, and rehabilitation services for older people in care homes.

(iv) Urgent and emergency care, improving coordination of services and reducing pressure on A&E departments.

(v) Acute care collaborators, linking local hospitals to improve the clinical and financial viability.

This paper examines the relationship between the prevalence of the urgent and emergency care vanguard (UEC) and local DTOC rates. Eight UEC vanguards were announced to take effect in July-August 2015 with a planned end date of March 2018. The vanguards were developing a new way to improve the coordination of services [12]. UEC models of care largely involved integrated urgent care accessed through NHS 111 alongside developing a channel shift modeling tool that included planning for discharge from the hospital at the point of admission [13]. Based on these points identified in the UEC vanguards programme, we anticipated to observe an impact on DOC rates following the implementation of the vanguards.

The current paper builds on the authors' previous work [14] to look further into the relationship between the UEC vanguard and DTOC. Previously the authors have used a synthetic control estimation method whereby 29 local authorities (LAs) identified to be involved in the UEC vanguard were averaged into a single "treated" unit and compared with a unit created using data from non-UEC English LAs to estimate the impact of UEC vanguards on DTOC days. Synthetic control estimation showed a large difference in DTOC days between UEC and non-UEC LAs, with an average of 23.7% lower DTOC per quarter (491 DTOC days per quarter). The authors found no indication of UEC participant sites having lower DTOC rates before the initiation of vanguards. The authors highlighted that the evidence indicated a sizeable statistically significant impact of UEC vanguards on DTOC, however, more research would be required to explain the underlying reasons for this relationship [14]. Consequently, further analysis was conducted to account for the fact that DTOC rates at the LA level are calculated based on the geographical residence of patients, while hospital services that observe the UEC practices applied may receive patients from many LAs. Therefore, we created a measure of exposure to UEC vanguards that measures involvement in this programme based on the residence of patients who used UEC partner hospitals. This is a novel measure that allows measuring what proportion of each local authority was influenced by UEC vanguards more precisely. In addition, we estimate the effect of UEC vanguards on DTOC rate allocations based on the sector responsible for the delay and a range of different reasons for the delay, which provides further insight into how and why this integration initiative could have been successful at lowering DTOC rates.

## 2. Methods

LA was chosen as a geographical level for analysis as the covariates that help to explain DTOC are at the LA level. Quarterly data on DTOC at the local authority level were collected for 150 English local authorities (LAs). The city of London and the Isles of Scilly were excluded due to differences in size in comparison to other LAs.

DTOC data is available from NHS England from 2010 quarter 4 onwards and includes information on the number of patients delayed and a number of days delayed. The data also have breakdowns by sector for the delay: acute and nonacute; NHS, social care, or both (NHS and social care); and also by reason of delay: completion of the assessment, public funding, waiting for further NHS nonacute care, awaiting residential home placement or availability, awaiting nursing home placement or availability, awaiting care package in own home, awaiting community equipment and adaptations, patient or family choice, disputes, housing patients not covered by NHS, and community care.

The eight UEC vanguards took effect in August 2015, as identified in the NHS England (2016) publication "*New Care Models: Vanguards, Developing a Blueprint for the Future of NHS and Care Services*" [11]. Consequently, we used the 2015 calendar year quarter 3 as the start of the vanguard programme, since there is a lack of information in regard to the specifics of local implementations of the vanguard initiative. Analysis was primarily based on a data sample that included information from 2012 to 2017 (150 LAs ∗ 24 quarters = 3,600 obs.). We excluded the first few quarters of available DTOC data aiming to ensure consistency of DTOC data quality and to achieve more balance before and after the UEC vanguard sample. We ran regressions using the full available sample (150 LAs ∗ 29 quarters = 4,350 obs.) alongside robustness checks, the results of which are presented in Supplementary Table A2. We also provide AIC and BIC for each regression, indicating goodness of fit. These criteria indicate that regressions with a more balanced sample offer a better fit, for which reason its results are preferred.

*2.1. Exposure to the UEC Vanguard.* An exposure to UEC vanguard variable was constructed that took into account which NHS trusts and their hospitals are UEC vanguard partners, and what proportions of each LA population stayed there overnight or longer (based on Hospital Episode Statistics (HES)) [15]. This way we obtained an exposure measure for the proportion of each LA population that was benefiting from services from UEC vanguard partner hospitals. The exposure variable was constructed as a constant and did not vary over time within our analysis. Having the exposure variable as a constant based on the information before the start of the vanguard programme allows us to mitigate the potential concern of reversed causality, such as the possibility that hospitals with lower DTOC could attract more people from surrounding LAs.

We plot the distribution of the resulting exposure to the UEC vanguard variable in Figure 1, with vertical lines that represent cut-offs used for further group analysis. We grouped LA's exposure to UEC vanguard into four categories: (i) 13 LAs were identified as those with "high" exposure (60% and over), (ii) 16 LAs with medium (4.5–60%), (iii) 16 LAs with low (1–4.5%), and (iv) 105 as not exposed (below 1%, none are 0%). The histogram in Figure 1 shows a clear distinction between the high exposure group and the rest of the exposed local authorities. However, the cut-off point between medium and low exposure groups was based on homogeneity in numbers for both groups (both include 16 local authorities). This grouping was not used in regression estimations but rather as means of interpreting the regressions' results and for visual presentation of data trends.

*2.2. Regression Analysis.* To examine the net effect on outcomes attributable to the UEC, we ran two-way (LAs, $c_i$ and quarter, $\lambda_t$) fixed effect panel regressions with random error term $u_{it}$:

$$\operatorname{asinh}\left(\frac{DTOC}{pop}\right)_{it} = VE_i\beta_1 + X_{it}\beta_2 + c_i + \lambda_t + u_{it}. \quad (1)$$

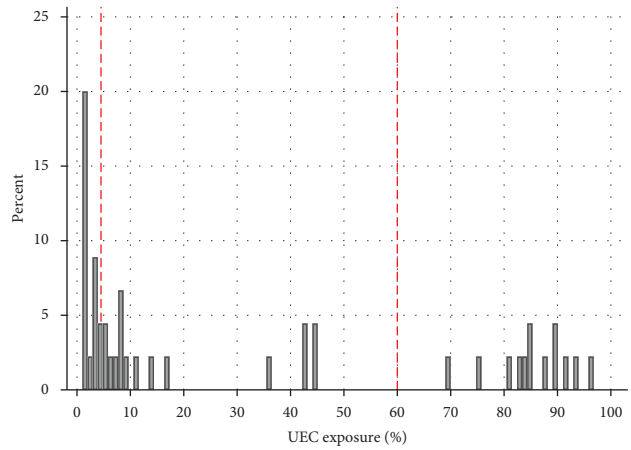


Figure 1: UEC vanguard exposure kernel density histogram. *Note*: it includes 45 LAs and excludes exposure between 0 and 1% (105 LAs, 70% of all LAs).

The main outcome of interest is the natural logarithm of the ratio of total delayed days to 1,000 of the population (transformation using command asinh, it produces inverse hyperbolic sine transformation which helps deal with zero values and values between zero and one). We also estimated variants of the model with DTOC breakdowns by sector and reason for delay. The subscript $i$ indicates a local authority, $t$ time (in quarters). UEC vanguard participation exposure $VE_i$ was identified as a ratio of LA population that stayed in UEC vanguard affected hospitals (continuous, ranging from 0 to 1), fixed in time after the programme started, 2015 quarter 3, and 0 before. The coefficient of interest for the analysis is $\beta_1$, showing the % effect on DTOC days for a 1% increase in LA's exposure to the UEC vanguards. $X_{it}$ is a vector of control variables, with $\beta_2$ being the associated vector of coefficients.

In all regressions, we controlled for local demand and supply information which are expected to help explain DTOC rates: benefits uptake (ratios of job seeker's allowance, pension credit, career's allowance, and disability living allowance), care home supply, the population aged 65+, wealth (house prices, single person house ownership with mortgage and outright), and LA geographical characteristics (rural or hub; area; LA type: metropolitan, London, county; the number of CCGs to LA). Care home supply was measured as a count of beds in an LA taken from the care quality commission (CQC) database of registered health and social care providers. All care homes are legally required to be registered with CQC. Data for local demand and supply characteristics were taken from NHS Digital, Office for National Statistics, and The Land Registry. There was no missing information during the time period of our analysis, though not all controlling variables vary by quarter, some provide annual information and some are used as constants over the analysis period. Supplementary Table A1 reports descriptive statistics of the control variables in use and their source and variability.

Table 1: UEC vanguard exposure categories.

| Exposure to UEC type | High | Medium | Low | Not exposed |
|---|---|---|---|---|
| No. of LAs in category | 13 | 16 | 16 | 105 |
| Mean DTOC days | 2711.79 | 5619.27 | 3408.65 | 2363.68 |
| Mean DTOC to 1 k pop | 7.11 | 8.01 | 6.56 | 6.98 |
| Mean DTOC to 1 k pop before | 6.90 | 7.40 | 6.37 | 5.96 |
| Mean DTOC to 1 k pop after | 7.48 | 9.02 | 6.87 | 8.69 |
| Exposure (%) | 60+ | 4.5–60 | 1–4.5 | 0–1 |
| Mean exposure (%) | 85.44 | 19.34 | 2.23 | 0.16 |

*Note.* Before and after indicate the start of the UEC vanguards programme in quarter 3 in 2015, based on a balanced sample of 3,600 obs.

*2.3. Sensitivity Analysis.* Different specifications were explored regarding the expression of the main dependent variable and sample variations. Residual analysis and AIC/BIC model selection criteria revealed that the dependent variable being expressed as a natural log was preferred. We explored the use of different samples: full that included last quarter of 2010 to last quarter of 2017 (150 LAs ∗ 29 quarters = 4,350 obs.), excluding years 2010 and 2011 (main analysis), excluding extremities: first and last 1% and 5% of the sample, and finally excluding first 12 quarters (4 years) of data. Two additional sets of regressions were conducted: (a) exposure variable reduced to 0 for those LAs where exposure to UEC was less than 5%, and (b) exposure variable being reduced to 0 for those LAs where exposure was less than 35%. The variations did not change the results or the differences were minimal within the same expression of the dependent variable. Regression results for different samples are available in the Supplementary Materials section (available here).

## 3. Results

*3.1. Descriptive Analysis.* The resulting exposure to the UEC vanguard of the 150 LAs in England is reported in Figure 1. The population living in 105 LAs experienced no exposure/very little exposure to the UEC programme (less than 1% of their population was admitted in 2015 to hospitals that later became UEC vanguard). For the population living in the most exposed (13 LAs), we estimated an exposure to UEC greater than 60%. Table 1 shows descriptive information on exposure groupings, which includes average DTOC days, DTOC to 1,000 population (both for the whole sample period between 2010 and 2017), and DTOC to 1,000 population before and after UEC vanguard for each group. The before and after vanguards split shows all the groups had lower DTOC rates before the start of the vanguards, however, medium and no exposure groups experience the largest increases in DTOC after the start of the initiative. The 16 LAs flagged with a medium exposure to the UEC programme are different from the rest with higher mean DTOC days and higher DTOC to population ratio, suggesting some LAs with larger populations are part of this group.

Figure 2 displays the relationship between UEC exposure and DTOC rates. We smooth the quarterly series by plotting estimates of DTOC for these four groups over time using local linear regressions [16]. The vertical red dashed line in quarter 20 indicates the start of the UEC vanguard scheme. The main difference of interest is between the red (105 not exposed LAs) and blue (13 high exposure LAs) lines. The figure reveals that not exposed LAs started with lower DTOC, but it increased significantly since quarter 16, while high exposure to UEC LAs started with higher DTOC but remained steady over time, not experiencing the increase in DTOC observed in most other LAs in England.

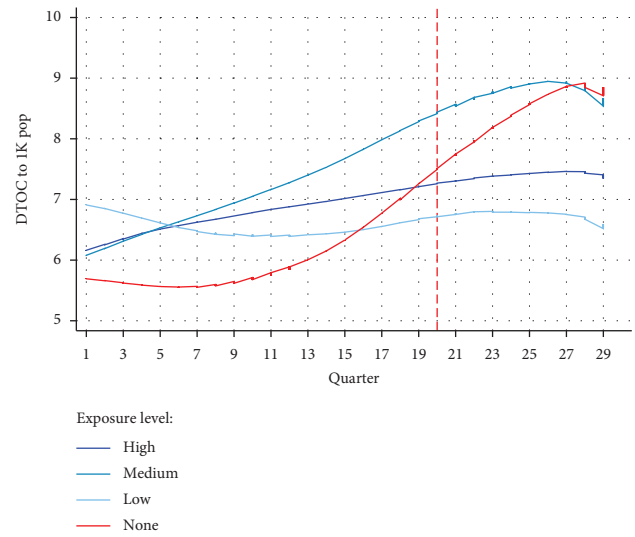


Figure 2: UEC vanguard exposure categories and DTOC to 1 k of the population over time.

Descriptive statistics of DTOC days over the study period are available in Table 2. We reported the overall means and standard deviations as well as the breakdown of DTOC days by sector responsible and the reason for the delay. Most delays were associated with the acute care sector, i.e., delayed discharges from short-term care, opposite of chronic longer-term care, and associated with a problem in NHS services, as opposed to social care (means of 1838.08 and 1778.78 days, respectively, of 2852.57 total DTOC days). The two main identified reasons were as follows: waiting for further NHS nonacute care, i.e., further intermediate or interim care (mean 532.69 days), and completion of the assessment of their future care needs, or the identification of an appropriate care setting (mean 498.66 days). Breakdowns of how DTOC to 1 k pop varied over time by sector and reason are available in Supplementary Figures A1 and A2.

*3.2. Regression Results.* In Table 3, we report the results from the regressions for overall DTOC and by sector and reason for delay. Our results indicate a 0.3% reduction in overall DTOC days for every 1% of exposure to UEC vanguard. All sectors, apart from NHS, were associated with statistically significant reductions in DTOC days in relation to partnership with UEC vanguard. The sector associated with largest reduction in DTOC days due to UEC vanguard was social care, showing 0.7% reduction in DTOC for every 1% of UEC exposure. The next most responsive sector to UEC was DTOC due to nonacute care, with 0.4% reduction in DTOC days to every 1% of exposure to UEC vanguard.

Table 2: DTOC days by sector responsible and reason for the delay.

| Sector/reason | 2012–2017 | |
|---|---|---|
| | Mean | SD |
| DTOC | 2852.57 | 3233.047 |
| DTOC in acute care | 1838.08 | 2244.39 |
| DTOC in nonacute care | 1014.49 | 1194.50 |
| DTOC from NHS services | 1778.78 | 1937.99 |
| DTOC from social care services | 871.09 | 1326.56 |
| DTOC from NHS and SC services | 202.70 | 424.00 |
| Completion of assessment | 498.66 | 655.20 |
| Public funding | 121.09 | 179.90 |
| Waiting for further NHS nonacute care | 532.69 | 704.62 |
| Awaiting residential home placement or availability | 312.19 | 420.79 |
| Awaiting nursing home placement or availability | 378.11 | 535.51 |
| Awaiting care package in own home | 445.70 | 804.06 |
| Awaiting community equipment and adaptations | 75.31 | 111.31 |
| Patient or family choice | 362.14 | 448.72 |
| Disputes | 35.01 | 68.64 |
| Housing patients not covered by NHS and community care | 89.51 | 141.15 |

*Note.* 3,600 obs.

Table 3: Relationship between the UEC vanguard exposure and DTOC at LA level in England, the overall result and by sector identified as accountable and reason for delay.

| DTOC definition | Coefficient (SE) | AIC/BIC | 95% CI |
|---|---|---|---|
| Overall | −0.003*** (0.001) | 2450.01/2641.86 | [−0.006, −0.001] |
| Acute | −0.003** (0.001) | 3283.185/3475.034 | [−0.006, −0.0005] |
| Nonacute | −0.004*** (0.002) | 4144.742/4336.591 | [−0.007, −0.001] |
| NHS | −0.001 (0.001) | 2680.062/2871.912 | [−0.003, 0.001] |
| Social care | −0.007*** (0.002) | 4373.215/4565.064 | [−0.010, −0.004] |
| Both (NHS and soc. care) | −0.003*** (0.001) | 1851.111/2042.961 | [−0.004, −0.001] |
| Assessment | −0.003*** (0.001) | 4115.272/4307.121 | [−0.005, −0.001] |
| Public funding | 0.001 (0.001) | −355.1738/−163.3244 | [−0.0005, 0.002] |
| NHS nonacute | −0.003** (0.001) | 2518.168/2710.018 | [−0.005, −0.0004] |
| Residential home | −0.002* (0.001) | 2335.48/2527.329 | [−0.004, 0.0003] |
| Nursing home | −0.002** (0.001) | 2056.605/2248.454 | [−0.004, −0.0003] |
| Care package | −0.005*** (0.001) | 2342.968/2534.817 | [−0.007, −0.002] |
| Community equipment | −0.001** (0.0003) | −4825.189/−4633.339 | [−0.001, −0.0002] |
| Patient/family | 0.001 (0.001) | 1702.072/1893.921 | [−0.001, 0.003] |
| Dispute | 0.0002 (0.0004) | −3915.408/−3723.559 | [−0.0005, 0.001] |
| Not covered | −0.0005* (0.0003) | −1090.158/−898.309 | [−0.001, 0.0001] |

*Note.* All DTOC expressed as log transformation of days to 1 k pop, FE panel regressions, years 2012–2017, and 3,600 obs. *** $p < 1\%$, ** $p < 5\%$, * $p < 10\%$; robust standard errors are in parentheses.

Regarding reasons for delay, waiting for care package at own home, completion of assessment and NHS nonacute care were the reasons for delay that were associated with the largest reductions in DTOC days due to UEC vanguard exposure (0.5%, 0.3%, and 0.3% reduction to every 1% of exposure, respectively). Reasons for delay that were found to not be impacted in a statistically significant way by the UEC vanguard exposure were public funding, patient or family choice, and disputes.

*3.3. Postestimation Analysis.* The main regression results were used to estimate the average net impact of UEC vanguard on DTOC for the four groups of LAs identified according to their exposure to the programme. Table 4 presents four different categories of % exposure to UEC vanguard and average estimated reductions in DTOC days based on mean % exposure in each category. We used information from Table 1 in combination with regression results from Table 3 to create Table 4, where we calculated the average impact % of UEC vanguards by multiplying the mean exposure % by the coefficient from the main regression result associated with this programme. The average impact in DTOC days for each category was calculated by multiplying the average impact % by the mean DTOC days and dividing by 100. The average impact in DTOC days to 1 k pop for each category was calculated by multiplying the average impact % by mean DTOC days to 1 k pop and dividing by 100. Based on mean UEC exposure in each category and using the result of 0.3% reduction from overall DTOC regressions from Table 2, the estimated average reduction in the high exposure category was equal to 775 DTOC days or the equivalent of 25.63% per quarter.

Table 4: UEC vanguard exposure categories and impact on DTOC.

| Exposure to UEC type | High | Medium | Low | Not exposed |
|---|---|---|---|---|
| Exposure (%) | 60+ | 4.5–60 | 1–4.5 | 0–1 |
| Mean exposure (%) | 85.44 | 19.34 | 2.23 | 0.16 |
| Average impact (%) (reduction) | 25.63 | 5.80 | 0.67 | 0.05 |
| **Avg. impact in DTOC days** | **−775.20** | **−363.71** | **−25.40** | **−1.27** |
| 95% CI | [−1281.33, −269.08] | [−601.17, −126.25] | [−41.99, −8.82] | [−2.11, −0.44] |
| Avg. impact in DTOC to 1 k pop days | −2.03 | −0.52 | −0.05 | −0.004 |
| 95% CI | [−3.36, −0.71] | [−0.86, −0.18] | [−0.08, −0.02] | [−0.006, −0.001] |

*Note.* The average impact % was calculated by multiplying the mean exposure % by coefficient from ln DTOC to 1 k pop regression −0.003. Average impact in DTOC days for each category was calculated by multiplying the average impact % by the mean DTOC days and dividing by 100. The average impact in DTOC days to 1 k pop for each category was calculated by multiplying the average impact % by the mean DTOC days to 1 k pop and dividing by 100.

*3.4. Sensitivity Analysis.* As a sensitivity analysis, we explored different specifications regarding the expression of the main dependent variable and sample variations, available in Table A3 in the Supplementary Materials section. Residual analysis and AIC/BIC model selection criteria revealed that the dependent variable being expressed as a natural log is preferred. We explored the use of different samples: full, excluding years 2010 and 2011, excluding extremities: first and last 1% and 5% of the sample, and finally excluding the first 12 quarters (4 years) of data. We ran two additional sets of regressions with (a) the exposure variable reduced to 0 for those LAs where exposure to UEC was less than 5%, and (b) the exposure variable being reduced to 0 for those LAs where exposure was less than 35% (columns 3 and 4). None of these variations changed the results or the differences were minimal within the same expression of the dependent variable.

## 4. Discussion

In this paper, we explored the relationship between local authorities' exposure to the UEC vanguards initiative and DTOC rates. UEC exposure was based on the proportion of LA's population that was observed to use UEC vanguard partner hospitals just before the start of the programme. We assessed the effect of UEC exposure on total DTOC days and this was followed by DTOC breakdowns by sector responsible for delay and reasons for delays.

We find a statistically significant UEC exposure effect of around 0.3% reduction in total DTOC to a 1% increase of UEC exposure, a result robust to various specification checks. This is estimated to equal to a reduction of 775 DTOC days per local authority per quarter in high UEC exposure areas. Nonacute sector DTOC was found to be more responsive to UEC vanguards in comparison to acute sector DTOC (0.4% and 0.3% reductions, respectively, to every 1% of UEC exposure). DTOC due to social care was particularly responsive to UEC exposure (0.7% reduction to 1% exposure), while we found no statistically significant relationship of UEC vanguards on DTOC due to NHS. DTOC due to awaiting care package at own home was the reason associated with the highest impact of UEC exposure among the DTOC reasons range (reduction of 0.5% to 1% of exposure), followed by DTOC due to waiting for further NHS nonacute care and completion of assessment (−0.3% to 1% exposure). All three reasons were observed to be associated with the largest number of DTOC days, suggesting UEC vanguards were successful at helping alleviate the pressure associated with problems within the health and social care system. By contrast, DTOC due to family or patient choice, disputes, or public funding, i.e., what could be considered as external factors to the integration of services, saw no statistically significant association to UEC vanguards exposure. The UEC vanguards were specifically established to put in place a menu of initiatives that sought to streamline processes surrounding the discharge of patients. These included initiatives to improve coordination between acute hospitals and local health and care services, with a particular focus on facilitating discharge by improving processes for developing care packages and for competing assessments to support timely discharge. Our study suggests that these initiatives are associated with a significant improvement in rates of DTOC. The fact that this improvement only occurs for those categories of DTOC determined by the health and care system (i.e., the site of UEC focus) and not when DTOC arises out of patient-level factors suggests that the improvement seen is likely a consequence of the vanguard initiative.

The current paper builds on the previous analysis [14] by providing a more precise identification of the extent each LA was exposed to and potentially benefiting from hospitals that were UEC vanguard partners. DTOC breakdowns by sector responsible and by reason for delay additionally help refine the explanation regarding which reasons for the delay were particularly responsive to UEC vanguards, this offers better insight as to why this programme may have been successful in reducing DTOC. While the results are not directly comparable due to the different estimation approaches used, the results of the two studies show similar outcomes. The previous analysis finds UEC vanguard sites having on average 23.7% lower DTOC, while the current study estimates a 1% increase in UEC exposure resulting in a 0.3% reduction in DTOC (the equivalent of 30% total reduction in a 100% exposure LA). This is a considerable impact, especially when compared to the estimated results of previous integration programmes like BCF, which found a 0.073% reduction in delays to a 1% increase in BCF expenditure (7.3% to total BCF expenditure). However, it should be reiterated that these results are not directly comparable due to the different estimation strategies used. Yet the findings of the current study provide a good incentive to try to learn more from the UEC vanguard programme, especially when DTOC

contributes to a significant expenditure making it a concern for the policymakers. We believe the UEC vanguard programme should be an important reference to learn from for future integration initiatives.

There are several limitations in our work to be considered. Firstly, the breakdowns into reasons and sectors are frequently subject to disputes, since it is not easy to pinpoint the sector or reason causing the delay with certainty. Our approach to constructing the exposure variable as a constant could be considered another limitation, as it assumes the exposure to UEC vanguards of each LA does not vary over time, while it likely has varied somewhat. However, we do not anticipate this variation to be major and having exposure as a constant helps us mitigate reversed causality. Furthermore, this study is based on aggregate nation-level data, while individual-level analysis would provide a more precise estimation of the overall UEC vanguards effect, we feel it is important to consider and share aggregate-level findings. Finally, we do not offer a cost-benefit analysis of our results, primarily due to vanguard programmes taking a multifaceted approach to the integration of health and social care, which would require a separate study carefully considering the choice of outcomes for such evaluation for it to be comprehensive. Currently, the effect we observe on DTOC was not explicitly named among the main programme targets. Further work on this topic could benefit from individual-level data on DTOC to allow further refinements in results. Alternatively, a more qualitative approach looking into why collaboration and coordination of professionals were more successful in this integration initiative could offer additional explanations.

## 5. Conclusion

This paper estimates the relationship between exposure to UEC vanguards and DTOC rates at the local authority level with more precision. This research also offers a breakdown into sectors and reasons associated with the occurrence of DTOC. Our findings further support previous results of UEC vanguards being successful in reducing DTOC rates but provides further detail and insights into the mechanism of this process.

## Data Availability

Technical appendix, statistical code, and dataset used in this study are available from the corresponding author on reasonable request.

## Additional Points

Points Known About This Topic.The following are known about this topic: (i) delays in hospital discharges are costly to the healthcare system and frequently also have a negative impact on patients themselves; (ii) two main reasons for DTOC were identified as awaiting a care package in patients' own homes and awaiting further nonacute NHS care; (iii) integration of services is often seen as an answer to dealing with DTOC; one of such initiatives, UEC vanguards, was found to be associated with reductions in DTOC rates at LA level. *What Article Adds.* This paper adds the following: (i) a novel method of measuring exposure to UEC vanguards based on patients' residence at the local authority level, providing a more precise estimate of how much this vanguard affected each local authority; (ii) we find that 1% of exposure to UEC vanguards at LA level is associated with 0.3% reduction in overall DTOC rates; (iii) DTOC due to social care was particularly responsive to UEC exposure (0.7% reduction to 1% exposure); awaiting care package at own home, waiting for further NHS nonacute care, and completion of assessment were found to be the three DTOC reasons associated with the highest impact of UEC exposure (reductions of 0.5% and 0.3% and 0.3% to 1% exposure, respectively).

## Disclosure



## Conflicts of Interest

The authors declare that there are no conflicts of interest.

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## Supplementary Materials

Supplementary materials include the appendix to this research work, which contains descriptive statistics of variables used, graphic analysis of DTOC split by sector and reason, robustness checks for the relationship between UEC vanguard exposure and DTOC using a larger sample, and sensitivity analysis for the overall relationship using different approaches on how to measure UEC exposure and DTOC and various sample restrictions. We also include a STROBE checklist. (*Supplementary Materials*)

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