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Association between elevated weekend mortality and the seven-day hospital services programme in England: A retrospective longitudinal study

Charlotte Underwood, Matt Sutton, Rachel Meacock*

The University of Manchester, UK

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ABSTRACT

Background: Patients admitted to hospital at weekends experience higher mortality rates than those admitted during the week. The NHS in England has taken the lead internationally with attempts to tackle this issue. Four priority clinical standards for emergency care have been introduced with the aim of reducing the 'weekend effect'. We investigate whether implementation of this policy has been associated with changes in the weekend effect.

Methods: Retrospective observational study of 120 hospital Trusts in England. We use data on Trusts' performance against the clinical standards in 2015 and 2017, and estimates of Trusts' weekend effects in risk-adjusted mortality in financial years 2015/16 and 2016/17. We examine whether adoption of the standards is associated with the weekend effect.

Results: We detect little association between Trusts' mortality weekend effects in 2016/17 and their performance against the clinical standards in 2017. Changes in achievement of the standards between 2015 and 2017 were not associated with changes in the weekend effect between 2015/16 and 2016/17.

Discussion: Large improvements in performance against all four standards have not translated into reductions in the weekend effect. We find no evidence that England's policy is a beneficial way for health systems to respond to this phenomenon. Given the failure of the policy to achieve its aim, the current mandate for full compliance by 2020 requires urgent review.

1. Background

Patients admitted to hospital in an emergency at weekends have been found to experience higher mortality rates than those admitted during the week [1,2]. This so called 'weekend effect' has been documented in over 100 studies spanning many different health systems including Australia, Canada, the Netherlands, UK, and USA [3]. England has taken the lead internationally with attempts to tackle this issue through targeted policy intervention. This intervention occurred against a backdrop of continued heated debate around the underlying causes of the weekend effect [4]. The 'seven-day services' policy is designed to ensure that patients receive the same standards of care seven days a week [5], with the stated aim being "to reduce the deaths associated with the weekend effect" [6].

This policy intervention is focused on the introduction of four priority clinical standards for emergency hospital care. These standards stipulate timely access to care delivered by consultants (specialist physicians or surgeons) and to diagnostic services [7]. The standards were first developed in 2013 through expert consensus, drawing on existing recommendations of best practice from professional and national bodies [8]. The accompanying evidence review, however, presented no evidence of a causal relationship between the proposed standards and mortality [9,10]. Nevertheless, full compliance with all four standards is mandated for all hospitals in England by 2020 [11] and hospitals face the risk of financial sanctions if they do not comply [12].

Hospitals have been required to complete a self-assessment survey as part of efforts by the National Health Service (NHS) to track the progress of the seven-day services policy [13]. The first wave of this survey captured hospitals' performance against the standards in 2015. There was no association between hospitals' performance against any of these standards and the magnitude of their weekend effects, or the change in their weekend effects over the previous three years [14]. However, this analysis was limited to using perfor-

* Corresponding author at: 7.11 Williamson Building, The University of Manchester, Oxford Road, Manchester M13 9PL, UK.
E-mail address: rachel.meacock@manchester.ac.uk (R. Meacock).

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mance measures at one point in time. Furthermore, performance against the standards was only reported as an average across all seven days of the week, with the differential between weekday and weekend performance unknown.

Hospitals have been working towards implementing the four clinical standards since this original performance review. In this paper we utilise the second wave of data collected on hospitals' performance against the clinical standards to examine how performance has changed over time. We relate this to changes in the weekend effect over time. Our aim is to investigate whether progress towards full implementation of the seven-day services policy has been associated with changes in the extent to which mortality amongst weekend emergency admissions is elevated. We exploit data on the change in hospitals' performance against the standards over time, and refined reporting of performance separately for weekdays and weekends, to investigate whether there is any evidence that the policy has achieved its aim of reducing deaths associated with the weekend effect.

2. Methods

2.1. Data

We obtained the second wave of publically available data on hospitals' achievement against the four priority clinical standards from the NHS England website [15]. Hospitals were asked to self-report their performance against each of the four priority clinical standards for a consecutive seven day period between 15th March 2017 and 12th April 2017. The four standards are: time to first consultant review; access to diagnostics; access to consultant-directed interventions; and ongoing consultant review (Appendix A1 in Supplementary material) [7]. The data record, for each hospital Trust, the proportion of patients receiving care that met each of the four standards. This is reported separately for weekdays (pooled over all five days) and weekends (pooled over both days), in addition to a combined figure pooled over all seven days of the week.

The first wave of publically available data on hospital Trusts' achievement against the four priority clinical standards were downloaded from the My NHS website [16]. This data is described as relating to the summer of 2015 [14]. Performance was only reported as an average across all seven days of the week in this earlier wave of data collection.

Data on mortality within 30 days of emergency admission were obtained from the NHS Digital website. These figures have been made publically available by the national information and technology partner of the NHS in England in order to aid research into seven day NHS provision [17,18]. We utilised the indicator comparing the odds of mortality for patients admitted at the weekend (Saturday and Sunday) to the odds of mortality for patients admitted midweek (Tuesday, Wednesday, and Thursday). We use the indicator relating to mortality amongst emergency admissions as the four priority clinical standards relate to emergency patients only.

These mortality figures are published as odds ratios. In estimating these odds ratios NHS Digital applied risk-adjustment models controlling for primary and secondary diagnoses, age, gender, ethnicity, deprivation, seasonality, admission source (usual place of residence vs other), and prior admission history over the past year [17,18], applying a similar methodology to that employed by Freemantle et al [19]. The data used to produce these mortality odds ratios originate from Hospital Episode Statistics data linked to the Office for National Statistics death registrations data.

We matched the mortality indicator for the financial year 2015/16 (1st April 2015 to 31st March 2016) to the first wave of the clinical standards survey data collected in summer 2015. We matched the mortality indicator for 2016/17 (1st April 2016 to 31st March 2017) to the second wave of the clinical standards survey data collected in March/April 2017.

2.2. Analysis

We first calculated the mean change in achievement, measured in percentage points, against each of the four standards over time between 2015 and 2017. The mean change over time in the weekend mortality odds ratios for emergency admissions was also calculated between 2015/16 and 2016/17.

We then calculated the ratio of weekend/weekday performance against each of the four standards for each hospital Trust in the second wave of survey data, where performance was reported separately for weekdays and weekends. This new variable takes values of less than one when weekend performance is lower than weekday performance and values of more than one when weekend performance is higher than weekday performance. A value of one indicates that a hospital Trust achieved the same level of performance against the standard on weekdays and weekends. Scaled this way this variable is centred on a value of one, as are the mortality odds ratios.

We then used multivariable linear regression models to examine the relationship between hospital Trusts' weekend effect mortality odds ratios and their achievements of the four standards. First, we related the weekend effect in the most recent financial year (2016/17) to achievement of the standards pooled across all seven days at the end of that financial year.

However, it may not be the average level of achievement against the standards across all seven days of the week that matters for the weekend effect, but the differential between weekday and weekend performance. We exploit the refined reporting of performance data separately for weekdays and weekends in the second wave of survey data to investigate this possibility.

We examine the relationship between hospital Trusts' weekend mortality odds ratios and the ratio of their achievement of each standard between weekends and weekdays. If the weekend effect in mortality is driven by the differential between weekday and weekend performance against the clinical standards we would expect to detect a negative relationship between this ratio variable and the weekend effect odds ratio. This would indicate that the weekend effect in mortality is higher for hospital Trusts which have lower weekend performance compared to weekday performance against the standards.

Finally we examined the association between the *changes* in the weekend effects between 2015/16 and 2016/17 and the *changes* in the levels of standard performance between 2015 and 2017. These changes were expressed as absolute differences between the mortality odds ratios and percentage point changes in standard performance. Due to the lack of refined reporting of standards achievement separately for weekdays and weekends in the first wave of survey data, this analysis could only be performed on the change in performance pooled over all seven days of the week.

To account for the fact that the published odds ratios are non-linear transformations of the underlying mortality rates we repeat the above analyses using logged values of the odds ratios. We related the logged weekend effect odds ratio in the most recent financial year (2016/17) to achievement of the standards pooled across all seven days in 2017. We then related the log of the weekend effect odds ratio in 2016/17 to the log of the ratio of achievement of each standard between weekends and weekdays. Finally, we related the change in the logged weekend effect odds ratio between 2015/16 and 2016/17 and the change in the levels of standard performance between 2015 and 2017.

All analyses were undertaken using Stata version 15. We used robust standard errors throughout to allow for heteroscedasticity.

Table 1
Hospital achievement against the seven-day clinical standards.

Clinical standard	Performance across seven days of the week 2015 Mean (SD) [Range]	Performance across seven days of the week 2017 Mean (SD) [Range]	Change in performance across seven days of the week (2017-2015) Mean (SD) [Range]	Performance on weekdays 2017 Mean (SD) [Range]	Performance on weekends 2017 Mean (SD) [Range]	Ratio weekend/weekday performance 2017 Mean (SD) [Range]
Time to first consultant review	0.494 (0.296) [0.000, 1.000]	0.728 (0.112) [0.433, 1.000]	0.234 (0.290) [−0.396, 0.893]	0.735 (0.112) [0.416, 1.000]	0.709 (0.139) [0.429, 1.000]	0.967 (0.132) [0.591, 1.268]
Access to diagnostics	0.765 (0.154) [0.214, 1.000]	0.951 (0.058) [0.679, 1.000]	0.187 (0.153) [−0.089, 0.697]	0.997 (0.030) [0.679, 1.000]	0.906 (0.105) [0.541, 1.000]	0.909 (0.103) [0.541, 1.000]
Access to consultant-directed interventions	0.900 (0.161) [0.000, 1.000]	0.955 (0.072) [0.556, 1.000]	0.055 (0.169) [−0.444, 1.000]	0.971 (0.065) [0.556, 1.000]	0.939 (0.094) [0.556, 1.000]	0.967 (0.076) [0.625, 1.125]
Ongoing consultant review	0.545 (0.284) [0.000, 1.000]	0.852 (0.126) [0.000, 0.997]	0.308 (0.289) [-0.454, 0.890]	0.905 (0.123) [0.000, 1.000]	0.710 (0.164) [0.000, 0.992]	0.781 (0.137) [0.395, 1.229]

Notes: N = 120 hospital Trusts.

Ethical approval was not required as all of the data utilised in this study is publicly available.

3. Results

NHS Digital published weekend mortality odds ratios for 135 hospital Trusts in 2016/17. Wave 2 information on achievement of clinical standards in 2017 was available for all of these 135 Trusts. However, corresponding weekend mortality data for 2015/16 and wave 1 clinical standards data for 2015 were only available for 120 of these 135 Trusts. Our analysis therefore contains data on 120 Trusts. The weekend effect for emergency admissions in 2016/17 was not significantly different among the 15 Trusts for whom wave 1 data was not available compared to the 120 Trusts for whom it was (1.095 vs 1.126; $p = 0.221$).

Table 1 presents descriptive statistics summarising hospital Trusts' performance against the four priority clinical standards. In both waves of the survey, performance over seven days was highest against the standard for access to consultant-directed interventions, and lowest against the standard for time to first consultant review. In 2017 on average hospital Trusts reported that 95.5% of patients received care that met the access to consultant-directed interventions standard, whilst 72.8% of patients received care that met the time to first consultant review standard.

Whilst performance improved against all four clinical standards, the largest improvement in performance between 2015 and 2017 was made against the standard for ongoing consultant review (Table 1). On average hospital Trusts reported that 54.5% of patients received care that met the standard for ongoing review in 2015. This increased to 85.2% in 2017, representing an improvement of 30.8 percentage points. The variation in performance between hospital Trusts has reduced over time amongst all four clinical standards.

The refined reporting of performance separately for weekdays and weekends in the 2017 survey shows that average performance is higher against all four clinical standards on weekdays than weekends (Table 1). Hospital Trust performance was highest against the access to diagnostics standard during the week, and the access to consultant-directed interventions standard during weekends. Performance was lowest against the time to first consultant review standard on both weekdays and weekends. The differential between weekend and weekday performance was smallest for the time to first consultant review and access to consultant-direct interventions standards, and largest for ongoing consultant review.

The weekend effect figures provided by NHS Digital are expressed as odds ratios, with a value of 1.000 indicating no difference in the risk-adjusted mortality rates for patients admitted on weekdays and weekends. Values of greater than 1 indicate an increased likelihood of mortality for patients admitted on weekends compared to weekdays [20]. The average hospital Trust weekend effect in mortality amongst emergency admissions was 1.119 (SD 0.082) in 2015/16. Average hospital Trust weekend effect in mortality increased slightly to 1.126 (SD 0.092) in 2016/17. The mean change over time was 0.007 (SD 0.118), ranging substantially from −0.386 to 0.304.

The correlations between the achievement of each of the four clinical standards on weekdays and weekends are shown in Appendix 2 Supplementary material. We find that there is no relationship between performance on any of the standards on weekdays. Three of the six correlations are positive, three are negative, and all are weak and statistically insignificant. We do, however, detect more of a pattern on weekends. All six of the correlations are positive, meaning that Trusts that perform well on one standard at weekends also tend to perform well on the other standards at weekends. Four of the six correlations are statistically significant, but all are still weak in magnitude, meaning that performance between each standard is only weakly related.

The correlations between performance on each of the four clinical standards on weekdays and performance on weekends are presented in Table 2. There is a positive and significant correlation between Trusts' performance levels on weekdays and weekends for each of the four standards. This means that Trusts that perform well against a given standard on weekdays also tend to perform well against that standard on weekends. The correlation between weekday and weekend performance is strong for all but the access to diagnostics standard, which only exhibits a weak correlation.

The correlations between Trusts' performance against each standard in 2015 and 2017 were all positive (Table 2). Only the correlations for the time to first consultant review and access to diagnostics standards were statistically significant. These correlations were weak in magnitude, meaning that performance against each standard is only weakly persistent over time.

Table 2
Correlations between performance on each clinical standard on different days and between different time periods.

	Between weekday performance and weekend performance in 2017	Between performance across seven days in 2015 and performance across seven days in 2017
Clinical standards	Correlation (95% CI)	Correlation (95% CI)
Time to first consultant review	0.739 (0.646, 0.811)	0.244 (0.067, 0.405)
Access to diagnostics	0.208 (0.030, 0.373)	0.211 (0.033, 0.376)
Access to consultant-directed interventions	0.639 (0.520, 0.734)	0.116 (−0.064, 0.289)
Ongoing consultant review	0.696 (0.591, 0.778)	0.178 (−0.002, 0.346)

3.1. Relationship between the weekend effect and clinical standards performance in 2017

The estimated associations between hospital Trusts' weekend effect mortality odds ratios in 2016/17 and their achievement of the four clinical standards in 2017 are presented in Table 3. When examining performance against the standards across all seven days of the week, only the access to consultant-directed interventions standard was found to have a statistically significant relationship with the level of the weekend effect in 2016/17. This relationship is positive, meaning that hospital Trusts who achieve higher performance against this standard have higher weekend mortality odds ratios. Although the magnitude of this effect size is large (a percentage point increase in performance against the access to consultant-directed interventions standard is found to be associated with a 0.2557 increase in the weekend effect mortality odds ratio), this should be interpreted in the context of the descriptive statistics presented in Table 1. These show that there was little variation in performance against this standard across Trusts, with mean performance at 95.5% (SD 0.072). Whilst the other three clinical standards show negative associations with the level of the weekend effect in 2016/17, these are small in magnitude and not statistically significant. The pattern of results is the same when examining the logged values of the weekend effect in 2016/17.

Table 3 also presents the associations between hospital Trusts' weekend mortality odds ratios and the ratios of their achievement of each standard between weekends and weekdays. When examining the relative differential between weekday and weekend performance three standards show a negative relationship with the weekend mortality odds ratios, whilst access to consultant-directed interventions shows a positive relationship. However, none of these associations are statistically significant.

When repeating the analysis using logged values of both the relative differential in standards performance between weekdays and weekends and of the weekend mortality odds ratios the pattern of results is very similar (Table 3). One of the four standards shows a statistically significant association with the weekend effect. The time to first consultant review standard demonstrates a statistically significant negative association with the weekend mortality odds ratio. This indicates that the weekend effect in mortality is higher for hospital Trusts which have lower weekend performance compared to weekday performance against this standard.

Using our logged model of the relative differential in performance between weekends and weekdays, we can predict what would happen to Trusts' weekend mortality odds ratios if the performance differential against the standards on weekdays and weekends was eradicated. This facilitates interpretation of the magnitude of the associations we investigate. If all Trusts were to achieve the same level of performance against the time to first consultant review standard on weekdays and weekends, our estimates predict that the mean Trust weekend mortality odds ratio would reduce by −0.006. This is from a mean of 1.126 in 2016/17. If all Trusts were to achieve the same level of performance against all four of the clinical standards on weekdays and weekends, our estimates predict that the mean weekend mortality odds ratio would reduce by −0.010. This would decrease the mean weekend mortality odds ratio from 1.126 to 1.116, meaning that patients admitted to hospital in an emergency at weekends would still be 1.116 times more likely to die within 30 days than patients admitted on weekdays.

3.2. Relationship between the change over time in the weekend effect and change over time in clinical standards performance

Finally we present the estimated association between the change in the weekend effect between 2015/16 and 2016/17 and the change in hospital Trusts' performance against the clinical standards between 2015 and 2017 (Table 4). The change in performance over time against two of the standards show a positive relationship with the change in weekend effect mortality odds ratios, whilst the change over time in the other two standards show a negative relationship with the change in weekend effect mortality odds ratios. None of these relationships are statistically significant. The pattern of results is the same when we examine the logged transformation of the weekend effect mortality odds ratios.

4. Discussion

4.1. Main findings

Elevated mortality rates amongst patients admitted to hospital at weekends have been documented across many different health systems worldwide. The NHS in England has taken the lead internationally with attempts to tackle this issue through targeted policy intervention. Four priority clinical standards have been introduced for emergency care with the aim of reducing the deaths associated with the weekend effect. However, we find little evidence that implementation of these four priority standards is related to the extent to which mortality amongst weekend emergency admissions is elevated.

When examining the latest wave of performance data against the clinical standards across all seven days of the week, we found performance on only one of the four priority clinical standards to be significantly associated with the level of the weekend effect. This relationship was, however, positive. This suggests that hospital Trusts who report higher performance against the consultant-directed interventions standard actually have larger weekend effects than Trusts who report performing less well against this standard.

When examining the relative differential between weekday and weekend performance against the priority standards, we find a significant negative relationship between log-transformed performance against the time to first consultant review standard and the log-transformed magnitude of Trusts' weekend effects. The relative differential in performance against the other three standards between weekdays and weekends is unrelated to the extent to which mortality is elevated for weekend admissions.

Despite large improvements in hospital Trusts' performance against all four priority clinical standards between 2015 and 2017, the average hospital Trust weekend effect in mortality actually increased slightly over this period. We found no association between the change over time in Trusts' performance against the four priority standards and the change over time in the magnitude of Trusts' weekend effects.

Table 3
Estimated regression associations between weekend mortality effects 2016/17 and performance against the clinical standards 2017 (top panel) and the difference in performance against the standards on weekdays and weekends 2017 (bottom panel).

	Odds-ratio	(95% CI)			Logged Odds-ratio	(95% CI)	
Performance across 7 days				Performance across 7 days			
Time to first consultant review	−0.0120	(−0.1558,	0.1317)	Time to first consultant review	−0.0046	(−0.1359,	0.1267)
Access to diagnostics	−0.0781	(−0.3553,	0.1991)	Access to diagnostics	−0.0625	(−0.3096,	0.1846)
Access to consultant-directed interventions	0.2557	(0.0279,	0.4834)	Access to consultant-directed interventions	0.2203	(0.0133,	0.4272)
Ongoing consultant review	−0.0474	(−0.1481,	0.0533)	Ongoing consultant review	−0.0498	(−0.1424,	0.0427)
Constant term	1.0049	(0.7208,	1.2890)	Constant term	0.0097	(−0.2481,	0.2676)
R^2	0.0426			R^2	0.0395		
N = 120				N = 120			
Differential in performance (weekend/weekday)				Logged differential in performance (week-end/weekday)			
Time to first consultant review	−0.1439	(−0.2909,	0.0030)	Time to first consultant review	−0.1270	(−0.2498,	−0.0041)
Access to diagnostics	−0.0430	(−0.2261,	0.1401)	Access to diagnostics	−0.0193	(−0.1563,	0.1177)
Access to consultant-directed interventions	0.1616	(−0.0338,	0.3570)	Access to consultant-directed interventions	0.1129	(−0.0358,	0.2615)
Ongoing consultant review	−0.0157	(−0.1270,	0.0956)	Ongoing consultant review	−0.0215	(−0.0932,	0.0502)
Constant term	1.1597	(0.8938,	1.4256)	Constant term	0.1058	(0.0795,	0.1320)
R^2	0.0669			R^2	0.0644		
N = 119				N = 119			

Note: One Trust reported values of zero for their performance against the ongoing consultant review standard on both weekdays and weekends in 2017. The number of observations therefore drops from 120 to 119 in the models of differential performance as the differential ratio is undefined.

Table 4
Estimated associations between the change in weekend mortality effects (2016/17–2015/16) and the change in performance against the clinical standards (2017–2015).

Change over time in performance	Odds-Ratio	(95% CI)		Logged Odds-Ratio	(95% CI)	
Time to first consultant review	−0.0180	(−0.0841,	0.0482)	−0.0144	(−0.0737,	0.0450)
Access to diagnostics	0.0280	(−0.1307,	0.1866)	0.0269	(−0.1121,	0.1660)
Access to consultant-directed interventions	−0.0043	(−0.1001,	0.0915)	−0.0040	(−0.0887,	0.0808)
Ongoing consultant review	0.0149	(−0.0522,	0.0821)	0.0134	(−0.0476,	0.0744)
Constant term	0.0015	(−0.0370,	0.0400)	−0.0003	(−0.0345,	0.0340)
R^2	0.0039			0.0038		
N = 120						

Notes: Changes are expressed as absolute differences between the odds-ratios and percentage point changes in standard performance.

When using our estimates to predict what would happen if the performance differential between standards achievement on weekdays and weekends was eradicated, we predict only very small impacts on Trusts' weekend mortality odds ratios. The associations detected in our analysis suggest that if all Trusts were to achieve the same level of performance against all four of the clinical standards on weekends and weekdays the mean weekend mortality odds ratio would reduce by just -0.010, from its 2017 level of 1.126. The magnitudes of the associations between performance against the priority clinical standards and weekend mortality odds ratios are therefore not large enough to explain the persistent weekend effect observed.

The seven-day services policy is founded on the assumption that mortality rates amongst patients admitted to hospital at weekends are higher because levels of staffing and service provision in hospitals are lower at weekends. Yet there is no causal evidence to support this assumption [9,10,21]. Previous research has shown that the weekend effect in England is in fact created by a reduction in admission volumes at weekends rather than an increase in the number of deaths [4,22]. It is therefore unsurprising that we find little association between the extent to which Trusts' implement the four priority standards and the magnitude of their weekend effects. The lack of causal evidence underpinning the policy was heavily criticised at the time of announcement [21], and our research further supports these criticisms.

4.2. Strengths and limitations

This is the first study to examine hospital Trusts' performance against the four priority clinical standards over time. It is also the

first study to exploit the refined reporting of performance separately for weekdays and weekends. This allowed us to examine whether increasing achievement against the priority clinical standards reduced the extent to which weekend mortality was elevated. It also allowed us to examine whether it is the relative differential in performance between weekdays and weekends that matters for the weekend effect.

The data on performance against the clinical standards are self-reported by Trusts, and therefore potentially subject to some bias. However, there is no reason to expect systematic patterns across Trusts in the level of bias between the two survey waves, meaning that any such bias would be unlikely to impact our analyses of change over time. Whilst the mortality data utilised measures the weekend effect over the entire financial year, data on achievement of the clinical standards only offers a snapshot of performance at one point in time.

Our analysis is unavoidably limited by the sample size of 120 hospital Trusts. It is therefore important to consider both the direction and magnitude of the associations we investigate alongside the statistical significance. Our predictions of the expected impact of eradicating the standards performance differential between weekdays and weekends illustrate that, irrespective of statistical significance, the magnitude of the associations we detect are not large enough to explain the persistent weekend effect observed.

Whilst we focus on the impact of the seven-day services policy against its primary aim of reducing deaths, mortality is not the only outcome of importance to patients. Further research is warranted to examine whether the introduction of the policy impacted other outcomes such as patient experience, and the mechanisms by which any detected associations occur.

4.3. Comparison with previous studies

Previous cross-sectional analysis of the first wave of performance data found no association between hospitals' performance against any of the four priority clinical standards in 2015 and the magnitude of their weekend effects in mortality [14]. Our analyses of the further implementation of the four priority clinical standards over an additional two year period largely concur with these conclusions. Gan and colleagues also found no difference in mortality rates for Trusts that had implemented seven-day services reorganisations compared to Trusts that had not [23]. However, their study was limited both by the use of crude mortality rates reported as averages across the week and by the identification of seven-day services reorganisations based solely on mentions in Trusts' annual reports.

4.4. Implications

Hospital Trusts in England have been working towards full implementation of the priority clinical standards for seven-day services since their development in 2013. However, our results suggest that large improvements in performance against all four priority clinical standards have not translated into reductions in the extent to which mortality is elevated amongst emergency weekend admissions. Whilst the weekend mortality effect has been documented in many countries, we find no evidence to suggest that England's policy is a beneficial way for other health systems to respond to this phenomenon.

Decision makers in other countries concerned about the weekend effect should first investigate whether its presence reflects increased deaths or merely reduced admission volumes at weekends in their respective health systems. Any attempts to tackle the weekend effect should be underpinned by causal evidence linking the planned intervention with mortality. England's experience with this policy should act as a cautionary tale against rushing to implement solutions to a perceived problem with the health system before fully understanding its underlying cause.

The cost of implementing the seven-day services policy across England was estimated to be between £1.07bn and £1.43bn annually [10]. Given the lack of evidence that this policy has met its stated aims, the current mandate for full compliance of all hospitals in England by 2020 requires urgent review.

Declaration of Competing Interest

None.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.healthpol.2019.09.004.

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