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Weekend working: a retrospective cohort study of maternal and neonatal outcomes in a large NHS delivery unit

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ABSTRACT

Objectives: Mandatory weekend working for NHS consultants is currently the subject of intense political debate. The Secretary of State for Health's proposed 7-day contract policy is based on the claim that such working patterns will improve patient outcomes. We evaluate this claim by taking advantage of as-if-at-random presentation of women for non-elective deliveries throughout the week. We examine (i) whether consultants currently perform fewer deliveries during weekends versus weekdays, and (ii) whether adverse outcomes increase during weekends.

Study design: We conducted a retrospective cohort study using data on all non-elective deliveries from January 2008 to December 2013 in a large UK obstetrics centre ($n = 27{,}466$). We used Pearson's chi-squared tests to make direct comparisons of adverse outcome rates during weekdays versus weekends. Outcomes included: estimated maternal blood loss $\geq$1.5 l; severe perineal trauma; delayed neonatal respiration; umbilical arterial pH $<$7.1; and critical incidents at delivery.

Results: Consultants currently perform the same proportion of non-elective deliveries on weekends and weekdays (2.3% versus 2.6%, $p = 0.25$). We found no increase in any adverse maternal or neonatal outcomes during weekends versus weekdays, despite high statistical power to detect such differences. Moreover, adverse outcomes are no higher during periods of the weekend when consultants are not routinely present compared to equivalent periods during weekdays.

Conclusions: Under current working arrangements, women who would benefit from consultant-led delivery are equally likely to receive one on weekends compared to weekdays. Weekend delivery has no effect on maternal or neonatal morbidity. Adopting mandatory 7-day contracts is unlikely to make any difference to either consultant-led delivery during weekends or to patient outcomes.

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Introduction

Increased risk of adverse events during weekends compared to weekdays in the UK National Health Service (NHS) has long been a concern of doctors, patients, and policy-makers alike [1]. This topic recently came into the public spotlight because of remarks made by the Secretary of State for Health, Jeremy Hunt: "Around 6,000 people lose their lives every year because we do not have a proper 7-day service in hospitals" [2]. Mr. Hunt further argued that requiring mandatory weekend-working contracts for consultants would increase their presence in hospitals during weekends and reduce these additional deaths. These remarks are echoed by current policy recommendations to improve NHS services by reconfiguring consultants' working hours [1].

Yet the presumed causal link between consultant working patterns and higher rates of adverse clinical outcomes is far from clear-cut. We aim to evaluate this link using data on consultants working within maternity services, which are a touchstone for the provision of safe and high-quality care across the NHS [3]. Specifically, we examine the risks of adverse outcomes arising from non-elective deliveries in a large UK centre. We compare complication rates during weekdays and weekends to determine (i) whether consultants perform fewer deliveries during weekends than during weekdays, and (ii) whether rates of adverse outcomes increase during weekends.

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Previous studies examining rates of neonatal deaths during weekends have demonstrated higher rates outside 09.00–17.00 on weekdays than at other times [4]. However, studies specifically comparing weekends to weekdays suggest no differences in neonatal death rates [5–7]. Aside from neonatal mortality, there is little evidence regarding rates of other serious adverse outcomes during weekends compared to weekdays, despite their potentially profound impacts on women and infants.

Our design takes advantage of several important features of obstetric data. First, delivery is a clearly defined, high-risk event at which the presence of a consultant could potentially reduce the risk of adverse outcomes [4]. Second, by limiting our focus to non-elective deliveries, our sample is plausibly distributed as-if-at-random between weekend and weekdays, since these women have not chosen when to deliver. This strategy avoids possible selection bias, where the weekend patient population differs from the weekday population in ways that are likely related to the risk of adverse outcomes. Third, the obstetric consultants in our sample have a clear and consistent working pattern throughout the study period, allowing establishment of a reliable link between day and time of delivery and the presence of a consultant.

Methods

32,078 deliveries occurred during a 6-year period (January 2008–December 2013) in a single large NHS maternity unit in the UK. Elective deliveries were excluded, as they are overwhelmingly more likely to occur during weekdays and carry a substantially lower risk of adverse outcomes. We identified a sub-cohort of 27,466 non-elective deliveries that occurred by spontaneous, instrumental delivery or non-elective Caesarean section for analysis. Inductions of labour were included, as initial analysis determined that these were no more likely to deliver during weekdays than at weekends. Spontaneous vaginal deliveries performed by midwives were also included since senior obstetricians may significantly influence decision-making and management during these deliveries. We also present results for a second separate sub-cohort of operative deliveries (both instrumental vaginal deliveries and non-elective Caesarean sections, $n = 9010$), as the outcomes of these deliveries are the most likely to be directly influenced by the presence of a consultant obstetrician.

In the study centre, 3 doctors are available for emergency work on the delivery unit at any given time. The difference in direct consultant presence on the delivery unit between weekends and weekdays is limited to the hours of 12.00–19.00. Outside of these times, the consultant is either present at the same times as during the weekdays (08.00–12.00) or is not present at either the weekends or weekdays (19.00–08.00). We therefore identified a third sub-cohort of non-elective deliveries that occurred between 12.00 and 19.00 ($n = 7361$) to allow separate analysis of outcomes during the time-period when no consultant is directly present during the weekends, but would have been on a weekday. No consultant opted out of weekend duty during the study period.

Study data were obtained from an electronic maternity data-recording system, which is updated by midwives shortly after delivery. The database is regularly validated by a rolling programme of audits, where the original case notes are checked against the information recorded. No patient-identifiable data were accessed in the course of this research, which was performed as part of a provision-of-service study for the obstetrics centre. Individual medical records were not accessed at any stage, and the study was therefore deemed exempt from full institutional review board approval.

Data obtained on delivery characteristics included maternal age in years (at time of delivery), BMI (measured at first trimester prenatal booking), parity (prior to delivery), and the birth-weight of the infant (recorded to the nearest gram). Gestational age was determined from first trimester ultrasound and recorded to the nearest week. Deliveries were classified as either spontaneous onset or induced. The healthcare professional delivering the baby was either a midwife or a doctor classified by years of specific obstetric training at the time of the delivery. Categories of experience were: $\leq$2 years (including those in the second year of foundation training, vocational general practitioner training, or the first 2 years of specialty training); 3–5 years (including both doctors in years 3–5 inclusive of their specialty training and those of equivalent experience not enrolled in a specialty training programme); $>$5 years (doctors in years 6/7 of the specialty training programme or those of equivalent or greater experience not employed as NHS consultants); and consultants (all of whom must have a minimum of 7 years obstetric training). Delivery type was classified as elective Caesarean section, emergency Caesarean section, instrumental delivery (sub-classified as forceps or ventouse) and vaginal deliveries (sub-classified as either breech or cephalic). Elective Caesarean deliveries were excluded from the analysis.

Outcome data on maternal and neonatal complications were obtained from the same database. Delay in neonatal respiration was defined as no spontaneous neonatal respiration within 1 min of delivery. Where the healthcare professional performing delivery deemed it necessary (typically all non-elective operative deliveries and those involving concern about neonatal well-being before delivery or at birth), the pH of umbilical arterial blood was tested immediately following delivery. Umbilical arterial pH was categorized as $\geq$7.1 or $<$7.1 [8]. A critical-incident form was generated at delivery in the case of any obstetric or neonatal emergency, including maternal death, full neonatal resuscitation, shoulder dystocia, maternal visceral injury or any other event triggering an obstetric emergency call. Maternal blood loss was estimated as soon as possible after delivery. Estimated blood loss was categorized as $<$1.5 l or $\geq$1.5 l. Severe maternal perineal trauma was defined as any third or fourth degree tear.

Standard significance tests were used to assess whether patients delivering at the weekend versus weekdays exhibited any imbalances in risk factors for adverse neonatal and maternal outcomes. A two-sided, two-sample t-test with unequal sample sizes was used for each continuous numerical risk factor (maternal age, maternal BMI, gestational age, and birth weight). A Pearson chi-squared test was used for each categorical risk factor (parity, race of the mother, delivery type, induction of labour, and the delivering healthcare professional).

All five adverse outcomes analysed are binary events. Complication rates on weekends versus weekdays were compared using two-sample tests of proportions with unequal sample sizes. For each outcome, a one-sided test was conducted, in which the alternative hypothesis is that the adverse-outcome rate is higher on the weekend than on the weekday. Compared with a two-sided test, this allowed greater power to detect excess complications for weekend deliveries.

Power calculations were performed for all comparisons of adverse-outcome rates. For each test, the minimum detectable effect size was calculated: that is, the smallest effect size (Δ) that could be detected at a significance level of 0.05 with power of at least 80%. These effect sizes are expressed as an absolute difference in rates (e.g. 4.9% on weekends versus 4.8% on weekdays is a $\Delta = 0.1\%$ effect size). These power calculations were initially performed using the standard Gaussian approximation to the binomial test but were also verified using Monte Carlo simulation. The Monte Carlo simulations showed slightly lower power than the Gaussian approximation. In our results, we therefore quote the more conservative numbers from the Monte Carlo simulations. Based on our findings of no statistically significant differences in

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