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New shift models for doctors in a large German University Neurosurgery Department: how they comply with the European Working Time Directive 3 years after implementation

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Abstract

Background Due to the European Working Time Directive (EWTD) and a new collective agreement for doctors working at University hospitals in 2006 new shift models had to be designed in the Department of Neurosurgery of the University Hospital Tübingen, Germany. The aim of the study was to show the fit of the models regarding the average weekly working time limits (aWTL), the daily maximum of 10-h working time (10-h dWT), and the staff expenditures 3 years after implementation.

Methods The new shift model was implemented in 2008, and hence planning and documentation were done electronically. Adherence to the work schedules was measured, and aWTL adherence rates were compared. The relative number of 10-h dWT violations in 2009 and 2010 was analysed. Staff costs relative to performance before and after implementation were calculated and tested using analysis of variance (ANOVA). Four other departments without alteration of shift models served as a control group in cost trend analysis.

Results In 2010 all doctors in the Department of Neurosurgery were able to stay within the limit of 54 h/week; one doctor without opt-out exceeded the 48 h/week limit (50.1 h/week). The median per capita rate of 10-h dWT violations in 2009 was 20.3 % of all eligible working days and further declined to 10.7 % in 2010 (p<0.001). Staff costs per case-weight point did not change significantly (2007: 339.88 €, 2009: 307.99 €, 2010: 322.54 €; p=0.22) in neurosurgery or in the control group (2007: 633.72 €, 2009: 637.06 €, 2010: 690.30 €; p=0.67).

Conclusions After implementation of the new shift model, current monitoring and properly matching modifications led to long-term stability in complying with the EWTD regulations without increasing costs for staff expenditures.

Keywords Neurosurgery · Working time · Shift models · Doctors · University Hospital

Introduction

The situation for postgraduate education and working time regulations in neurosurgery varies among western countries.
Whereas within the US there is debate about weekly working hour restrictions for residents to 80 h or less [1, 25] and weekly working hours between 80–90 h have been reported [20, 36], the European Working Directive [10] and court decisions [11, 12] have regulated working times of doctors in Europe to 48 h per week.

One central demand of the strike by German doctors working at university hospitals in 2006 was the improvement of working conditions. The patient care workload at university hospitals is additionally augmented by research and teaching activities. In German hospitals working hours of more than 50–60 h per week have been reported [18, 31]. Facing a decreasing number of young doctors, a trend to an increasing percentage of female colleagues, and changing attitudes towards a better work-life balance [8], German hospitals and especially surgical disciplines are being forced to adapt their shift models because excessively high weekly workloads are no longer tolerated. Although there is massive concern from the surgical disciplines with regard to impairing the training of young doctors working in accordance with the time directive [13], we have to take up the challenge.

In this report we show how the Department of Neurosurgery at the University Hospital Tübingen developed and introduced new shift models to comply with the EWTD, namely the average weekly working time limits (aWTL) and the daily maximum of 10 h working time (10-h dWT). We also observed the staff expenditures for 3 years after implementation.

### Methods

With 8,500 employees, more than 900 of which are doctors, the University Hospital Tübingen (UKT) is the largest employer within the Neckar-Alb region in southwest Germany. Approximately 63,000 inpatients and 360,000 outpatients are treated every year in 17 clinical departments and 9 institutes. Since 2009 the Department of Neurosurgery has had 71 beds, of which 14 are intensive care (ICU) beds and 4 are for presurgical epilepsy diagnostics. More than 2,700 operations in all categories are performed per year in four operating theatres (OR). Characteristics of the department are shown in Table 1. Training of young doctors is paramount, and the department was elected the first German postgraduate training site by the World Federation of Neurosurgical Societies (WFNS). It also has a strong scientific profile with more than 50 publications per year.

In 2007 the department was chosen by the Executive Board of the UKT to be one of four pilot departments for developing and implementing new EWTD-compliant shift models. A detailed description of the methodology can be found elsewhere [22]. The old shift model was characterised by a day shift from 07:06–16:00 h for all doctors. One of them (junior doctor, i.e. postgraduate years 1–6) also covered the following in-house on-call shift until the next morning, and one senior doctor (i.e. attending neurosurgeon) covered the on-call shift at home. Weekend days were covered by two 24-h on-call shifts (one in-house and one at home). The ICU had an early and a late shift for each senior doctor covering the time between 6:30–22:30 h Mondays to Fridays followed by an on-call shift at home for one of them. Additionally, one junior doctor worked from 9:00–18:00 h. The weekends were covered by an on-call shift at home for one of the senior doctors. This model resulted in a heavy workload for those doctors who were working on-call at night and on weekends, a very high workload for the two senior doctors on the ICU, as well as many hours of overtime in the afternoon/evening from Monday till Friday.

Major modifications of the shift model were the introduction of two late shifts for junior doctors (13:30–22:00 h) to cover (1) the work in the wards and in the OR, and (2) the work in the ICU. During the night, in-house coverage was maintained by one junior doctor on call backed up by an experienced neurosurgeon on call at home. Additionally, a new in-house on-call shift for another junior doctor for the ICU was established. The two senior doctors responsible for the ICU (anaesthesiologists) were reinforced by two other colleagues (neurosurgeons) with special ICU expertise to relieve their high workload resulting from night, weekend, and holiday coverage.

On weekends a second in-house on-call shift was established for junior doctors, both of which were composed of regular work between 9:00–15:30 h followed by time on call until the next morning. For the senior doctor on call at home, an in-house on-call episode was introduced between 9:00–12:00 h for visiting critically ill patients. Another modification was the implementation of a “late shift OR team” consisting of one senior neurosurgeon and two junior doctors to cover one OR from 13–21 h. The model is shown in Fig. 1.

| Table 1 Characteristics of the Department of Neurosurgery from 2007 to 2010. CMI: Case-mix index (average case weight per patient indicating complexity of cases) |
|---|---|---|---|---|
| 2007 | 2008 | 2009 | 2010 |
| Beds | 50 | 61 | 71 | 71 |
| Inpatients | 2,585 | 2,932 | 3,021 | 3,053 |
| Operations | 2,326 | 2,647 | 2,716 | 2,724 |
| Case-mix index | 2.88 | 3.20 | 3.34 | 3.30 |
maximum workload of 49% of the whole time on call, then an individual opt-out on a reversible basis is available for all doctors working in such a shift model. Opt-out is possible to an average of 58 h/week if the workload during in-house on-call duty is below 25% and to 54 h/week if the workload is between 25% and 49%. The latter was the case in the Department of Neurosurgery. Prior to the implementation of the new shift model, all doctors were asked if they wanted to adhere to the 48 h average working time per week or rather wanted to opt out to increase the permitted average working time per week to 54 h.

Besides the Department of Neurosurgery, the Departments of Anaesthesiology, General, Visceral, and Transplant Surgery, as well as Gynaeology and Obstetrics made up the pilot departments where new shift models were introduced. The control group consisted of the Departments of Neurology, Radiooncology, Ophthalmology, ENT, and Dermatology, whose shift models were unaltered between 2007 and 2010.

Statistics

Adherence to the aWTL was compared between the opt-out and non-opt-out groups with the two-tailed Fisher's exact test. The percentages of 10-h dWT violations in 2009 and 2010 were analysed using the t-test after log transformation. Monthly staff costs of both junior and senior doctors before and after implementation of the new shift model were evaluated by analysis of variance (ANOVA). To correct for the planned increase in surgical capacity, the costs were calculated relative to the case weights gained by the department within the German DRG system. Case weights are a typical element of a DRG system as they represent the economic severity of an inpatient case. The DRG catalogue lists a specific case weight for every DRG ranging for example in 2009 from 0.838 for an uncomplicated peripheral nerve surgery (DRG B17C) to 3.594 for a complex craniotomy (DRG B02E). Multiplying the case weight with the base rate (2,918.66 euros in 2009), one gets the bill the hospital can claim from the patient's health insurance company. Therefore, the more patients or the more complex patients that were treated within the Department of Neurosurgery, the higher were the earnings to compensate for higher staffing costs, for example. The statistical analysis was done with JMP 8.0.2 (SAS Institute, Cary, NC).

Results

The Department of Neurosurgery expanded in 2008-2009 with an increase in ICU beds from 10 to 14 and in normal beds from 40 to 57. Therefore, the number of doctors was increased by four, but the demands of the newly designed shift model required another 1.7 doctors FTE.

**Fig. 1** Redesigned shift model of the Department of Neurosurgery implemented in 2008

![Fig. 1](image-url)
with opt-out slightly above 54 h/week (55.0–55.0–54.7–54.3 h/week). In all of the four pilot departments, 164 doctors opted out and 82 did not in 2010. One hundred forty-one (86.0 %) doctors in the opt-out group were within their limit, and 54 (65.9 %) of the non-opt-out group (Fisher's exact test, p<0.0004).

**Daily maximum of 10 h working time (10-h dWT)** The median rate of 10-h dWT violations in 2009 based on all eligible working days was 20.3 % and dropped down to 10.7 % in 2010 (p<0.001), as shown in Fig. 3.

**Staff expenditures** As shown in Fig. 4 the mean staff expenditures per case weight and month for the years 2007, 2009, and 2010 were 339.88, 307.99, and 322.53 euros, respectively. There was no statistical difference (p=0.22) between the years. In absolute terms, staff expenditures for doctors rose from a mean of 214,649.80 euros per month in 2007 to 256,864.63 euros and 265,459.32 euros in 2009 and 2010, respectively. This represents a 23.7 % raw increase from 2007 to 2010 (18.9 % when corrected for the 4 percent increase in tariffs during that time). Likewise, performance increased from a mean of 637.6229 case-weight points per month in 2007 to 839.6714 in 2009 and 840.2484 in 2010.

The control group had staff expenditures per case weight of 633.72 euros in 2007, 637.06 euros in 2009, and 690.30 euros in 2010 (p=0.67).

**Discussion**

This evaluation shows for the first time the results of an EWTD-conformed adaptation of the shift model in a neurosurgery department of a university hospital with analysis of adherence to aWTL, 10-h dWT, and staff costs. After 1 year of implementation and “training” of proactive shift planning in 2008, the results in 2009 and 2010 showed rather good compliance with the EWTD limits. During the same time the performance of the department grew considerably with regard to the number of patients, operations, and thus case...
weight. This concomitant growth brought about the findings of insignificantly changed staff expenditures per case weight, although more staff was necessary to run the new shift model. Thus, the premise of the project to implement EWTD-conformed shift models without increasing costs relative to the earnings gained could be achieved. The internal control group where no modifications of the shift models have so far been done also showed no statistically significant changes of staff expenditures per case weight. Both groups were subjected to the same increases in staff costs between 2007 and 2010. Therefore, we can conclude that the modifications to implement a new shift model did not lead to higher staff costs relative to performance as compared to a control group without these modifications. Reports from the US assumed a considerable increase in absolute costs (up to 18%) when reducing working hours [26, 30] to 80 h/week. This is in accordance with our findings in absolute terms (18.9% increase of the monthly staff costs on a cost basis in 2007). However, not all of this increase was due to the new shift model itself (5.7% FTE) since four FTEs were required for the planned increase in the department's capacity.

One limitation of this study is certainly that it was single-centred and that we did not have another department of neurosurgery that could have served as a control group. However, we think that an internal control group consisting of other departments with surgical activities could at least control for effects such as increasing staff costs due to changing tariffs and adaptations of the German DRG catalogue and thus case weights over time. Another limitation is that direct comparisons between countries with different DRG systems or no DRG-based reimbursement system at all are impossible. However, our approach aimed at relating the increase in staff costs due to modifications of the shift model to the possible increase of performance and therefore revenues. We feel that focusing on the cost side alone is not enough to describe the effects of modified shift systems.

The implementation of a late surgical team within the neurosurgical department interfered with working schedules of three other disciplines (anaesthesiology, scrub nurses, anaesthesiology nurses) and could not be maintained after a pilot phase. This demonstrates the complexity of introducing new working schedules in a large health care facility. Nevertheless, violations of the 10-h dWT went down to 10.7%, meaning that on average on 1 day out of 10 a neurosurgeon has to work longer than 10 h. With respect to the emergency character of a neurosurgical department at a university hospital, we think that this is a quite acceptable achievement.

In conjunction with the high rate of opt-out in our Department of Neurosurgery, the aWTL of 54 h could be respected very well. We could also demonstrate that without opt-out there is an increased risk of violating the aWTL of 48 h, indicating that there were possibly not enough doctors to run the shift model appropriately.

However, the concern of the European Neurosurgical Societies and other surgical disciplines about possible negative implications of the EWTD as expressed in a common statement [13] is only in part applicable to the situation in Tübingen. Due to the high acceptance of opt-out, the annual working time can achieve up to 2,808 h per capita and still be in accordance with the EWTD regulations. The requirements of the junior doctors to see and treat a considerable number of patients within their 6-year training period should not disregard the need for senior professionals to work within reasonable limits for the 30–35 years thereafter. At the beginning of the new shift model in 2008, most of the violations of the aWTL resulted from senior professionals. There are several studies showing that very long working hours, distress, and fatigue decrease performance [2–5, 7, 19–21, 27, 35]. Therefore, a certain restriction of working hours per day or per week seems reasonable, especially in light of other high-risk sectors (e.g. air traffic, energy supply, etc.) that have adopted upper limits of working time. However, the chosen limits of the EWTD seem arbitrary (particularly with regard to the US), and there is considerable concern about how this will affect the quality and attractiveness of a career as a junior neurosurgeon [13, 15, 16, 23, 24, 28, 29, 33, 34]. In a recent study of neurosurgical residents on call, no differences in psychomotor or cognitive abilities could be found [14], and there is concern about increased morbidity in neurosurgical patients after the implementation of the 80-h work-week restriction [9]. An extensive review on that question found that work hour restrictions in the US did not negatively impact morbidity or mortality in surgical patients [17].

However, the complexity of such a shift model should not be underestimated, and slight alterations of the level of qualification of the involved doctors (number of senior doctors, advanced junior doctors, and beginners) can lead to a different perception. Pressure on all doctors in neurosurgery is still rising in Germany [32] and current adoptions of shift models are necessary. Maybe the currently chosen shift model we discussed here with the possibility to opt out to an average of 54 h per week in combination with some relief from administrative work by introducing case managers on the neurosurgery wards made it possible to find an acceptable balance between the legislative and personal needs of the neurosurgery staff. We hope to keep this balance between all stakeholders in the future and to contribute some “hard facts” to the debate of how the EWTD can be met without completely disrupting continuity in patient care and severely impairing resident training.
Conflicts of interest None.

References

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