



Work like a Doc: A comparison of regulations on residents' working hours in 14 high-income countries

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ARTICLE INFO

Keywords:

Medical residents
Work hours
Nightshifts
Cross-country analysis
EWTD
ACGME

ABSTRACT

Background: Medical residents work long, continuous hours. Working in conditions of extreme fatigue has adverse effects on the quality and safety of care, and on residents' quality of life. Many countries have attempted to regulate residents' work hours.

Objectives: We aimed to review residents' work hours regulations in different countries with an emphasis on night shifts.

Methods: Standardized qualitative data on residents' working hours were collected with the assistance of experts from 14 high-income countries through a questionnaire. An international comparative analysis was performed. **Results:** All countries reviewed limit the weekly working hours; North-American countries limit to 60–80 h, European countries limit to 48 h. In most countries, residents work 24 or 26 consecutive hours, but the number of long overnight shifts varies, ranging from two to ten. Many European countries face difficulties in complying with the weekly hour limit and allow opt-out contracts to exceed it.

Abbreviations: US, United States; ACGME, Accreditation Council for Graduate Medical Education the United States; EU, the European Union; EWTD, the European Work Time Directive; THE, Total Health Expenditure; GDP, Gross Domestic Product; HSPM, Health Systems and Policy Monitor; WWH, Weekly Working Hours; ND, Not Defined; RCT, Randomized Controlled Trial.

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<https://doi.org/10.1016/j.healthpol.2023.104753>

Received 5 January 2022; Received in revised form 13 February 2023; Accepted 15 February 2023

Available online 18 February 2023

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Conclusions: In the countries analyzed, residents still work long hours. Attempts to limit the shift length or the weekly working hours resulted in modest improvements in residents' quality of life with mixed effects on quality of care and residents' education.

1. Background

In many countries, medical residents work long, continuous hours [1], exceeding standards in other professions. In addition to the regular working hours, residents often work overnight shifts, which can extend to 26 continuous working hours or even more. Residents are also often expected to work over weekends and holidays. There is considerable evidence that, in the aggregate, sleep deprivation due to shifts of more than 16 h has a negative effect on the quality and safety of care, as well as on residents' quality of life. Quality of life can be measured in terms of health-related quality of life [2,3]; general assessments of quality of life [4–6]; burnout and exhaustion [5–8]; and work-life balance [6,7]. Working under conditions of extreme fatigue has been shown to harm residents' cognitive and clinical activity [9–11], and to increase the likelihood of medical errors [9,12–15]. Residents' fatigue is also associated with worse patient experience of care, an important component of quality of care [16]. Moreover, extended consecutive working hours have negative impacts on the residents themselves [17]. For example, studies among residents have found that the odds of suffering an accidental needle prick were higher after working long shifts [18,19]. Long resident working hours have also been associated with depression and anxiety [20], and increased risk of being involved in car accidents and near-miss accidents [16,17,19]. Nevertheless, it is difficult to demonstrate a direct effect of long working hours on treatment outcomes [4,5], in part because many other factors contribute to the residents' performance, such as seniority, case complexity, and interpersonal differences when functioning under fatigue conditions [21].

Over the years, many countries have attempted to mitigate these adverse effects by limiting residents' working hours [1], through five main strategies:

- 1 Limited shift length – in 2003, the United States (US) set a limit of 30 h for medical residents, following recommendations by the Accreditation Council for Graduate Medical Education (ACGME). In 2011, US residents' work directives were further amended, restricting first-year residents' shifts to 16 h, and limiting shifts for other residents to 28 h [22];
- 2 Rest breaks – reducing continuous duty hours without sleep by setting aside a certain number of hours for rest during a nightshift. For example in Israel, two hours are set aside during 26 h of continuous work [23];
- 3 Limited monthly night shifts – reducing night shift frequency, e.g., from once every two days to once every four days or limiting night shifts to no more than seven per month. For example, following the ACGME recommendations, the US now allows night shifts following a full day of work, but no more often than every third day [22,24];
- 4 Short consecutive night shifts – a scheduling system in which, once or twice a month, residents temporarily rotate to a night shift schedule for a few consecutive nights, working only relatively short shifts, such as four 13-hour night shifts in a row during the week, or three night shifts over the weekend. In the US and Canada, this format is often referred to as “night float” [2,3,25];
- 5 Limited weekly working hours – in 2003, the US set a limit of 80 weekly working hours for medical residents following ACGME recommendations [26]. In 2004, the EU extended the European Work Time Directive (EWTd), which specifies a limit of 48 weekly working hours, to include residents, including night shifts [27]. The directive mandated gradual implementation – from a 58-hour limit in 2004, through 56 in 2007, to 48 in 2009 [28].

The objective of the present study is to review strategies to reduce residents' work burden. Specifically, we review residents' working hours regulations in high-income countries, with an emphasis on night shifts.

2. Methods

This study used qualitative, cross-country, comparative analysis. Countries were sampled from the 57 members of the European Observatory on Health Systems and Policies (OBS), which include European countries, the US, Canada, and Israel.¹ The OBS includes a network of experts who collaborate in research, who were the main vectors of data collection for this study.

Out of OBS members, countries were purposefully sampled based on comparability in terms of resources that can be associated with residents' work, such as public funds available to the health system and rates of physicians per population. The inclusion criteria were total health expenditure (THE) as a percentage of gross domestic product (GDP), public expenditures as a share of THE, and rates of physicians per population (for a detailed list of criteria, see Table A1 in the supplementary online material). A total of 17 countries were finally sampled,² and experts from these countries were asked to participate in the study; 14 out of 17 agreed.

The tool used to collect data about residents' working hours in a standardized and comparable manner was a questionnaire developed by the authors (RMB, RW, AB, and AJR) (see Appendix in the supplementary online material). It included information about maximum weekly working hours, night shift duration, rest hours, and general work regulations in each country. Since the terms over residents' work models varies across countries (e.g. “on-call” may mean “on-call at workplace” or “on-call at home”), we defined “working hours” as “onsite working hours”, as opposed to “on-call hours (at home)”. To validate the tool, the questionnaire was first sent to experts from Canada, England, and the US, who provided feedback. The questionnaire was then sent to the coauthors (experts from the OBS Health Systems and Policy Monitor (HSPM) network (https://www.hspm.org/hspm_members.aspx), or experts on residents' work regulations indicated by the HSPM network). For each country, 1–4 experts completed the questionnaire between May and July 2020.

The experts extracted their data from regulatory documents, academic and gray literature, as well as interviews with residents from their respective countries. Data were analyzed using triangulation to increase the study's validity: two of the authors (RMB and RW) analyzed the data separately and filled in a summary table. To enhance the accuracy and reliability of the responses and analysis, data was sent back to the coauthors for feedback. All coauthors revised or confirmed the data analysis and interpretation.

3. Results

Data from fourteen countries were included in the final analysis: Canada (Ontario, here after, “Canada”), Czech Republic, England, Estonia, Finland, Germany, Hungary, Ireland, Israel, Latvia, Netherlands, Slovenia, Spain, and the US. Table 1 summarizes the

¹ <https://eurohealthobservatory.who.int/countries/overview>.

² Belgium, Canada (Ontario), Czech Republic, England, Estonia, Finland, France, Germany, Hungary, Ireland, Israel, Latvia, Netherlands, Portugal, Slovenia, Spain, US.

Table 1
Summary of residents' work regulations and work in practice, 2020.

COUNTRY	MAX SHIFT LENGTH (HOURS)	REQUIRED REST TIME DURING SHIFT (MINUTES)	MAX NIGHT SHIFTS PER MONTH	MAX WEEKLY WORKING HOURS (WWH)	NO. OF MONTHS FOR AVERAGING (WWH)	EXCEPTION TO WWH LIMIT	MAX WWH IN PRACTICE AND OPT-OUT	ENFORCEMENT	REGULATION SOURCE	REF.
Canada	26	ND	7-8*	60/80 ^A	ND	ND	70 weekly hours on average, may reach 100 h. 4 weeks of paid holiday a year	Limited enforcement	Local agreement	[33,34]
Czech Republic	16	30**	ND	40	12	48	Night shifts can be as long as 24 h. Alternative contracts allow working more than 48 h a week.	Non-compliant employers can be fined, but usually not implemented in practice	Local law (Labor Code) that follows EWTD	[54,55]
England	13	30**	4 per week***	48	6	56	No more than one weekend shift every three weeks. Residents may sign opt-out agreements to exceed the WWH limit to 56, and to work 5 consecutive shifts	Violations may be reported to HSE and employer subjected to sanctions	Junior Doctor Contract + EWTD	[35–40]
Estonia	24	30**	ND	40	4	ND	Exceptions are rare	Employer responsible to ensure compliance; complaints may be made to Labor Inspectorate	Local labor law + Collective bargaining agreement + Residency regulation	[41–44]
Finland	24	60	5	48	4	ND	Residents can opt out of the hour limit, approved by physicians' association. Shifts of 24+ h allowed if residents manage to rest during the shift.	[No data found]	Collective bargaining agreement + Local law	[45,46]
Germany	24	45	ND	42	12	80	Opt-out agreements to exceed WWH limit to 48; option for a combination of up to 13-hour shifts and "on-call system" in hospital	Electronic timekeeping system allows verifying if regulations are kept. However, residents register overtime manually	EWTD	[47,48]
Hungary	16	25	2	48	6	60	Residents may sign alternative contract allowing 32 h shifts	Limited enforcement	Collective labor agreement + Local law	[35]
Ireland	24	30**	ND	48	12	ND	Max 48 averaged over the reference period – the doctor's terms of employment or 12 months, whichever is shorter	WWH are reported monthly to HSE, which reports violations to Labor Inspectorate, and employer may be subjected to sanctions. Yet enforcement is	EWTD	[29–32, 35, 49–52]

(continued on next page)

questionnaire findings.

3.1. Work hours laws and regulations

In most European countries analyzed, additional regulation has been added to the EWTD, often through collective medical workforce agreements. These agreements are intended to adapt the EWTD to each country's specific context and integrate working regulations into the national remuneration agreements.

3.1.1. Limited shift length

In most countries (10 out of 14), medical residents work long shifts of 24 to 26 h, with the two-hour difference usually attributed to the time allotted for patient handoffs at the end of the shift (see second column in Table 1, "Max Shift Length (Hours)"). The 24/26 h shifts consist of a regular 8-hour day shift immediately followed by the night shift of

approximately 16 h. The long shifts are worked on a weekly or biweekly basis. Four countries do not follow this pattern: Czech Republic, Hungary, and Slovenia have set a limit of 16 h for each shift, although residents may consent to work longer, 24-hour (Czech Republic) or 32 h (Hungary and Slovenia); we do not have information about the frequency of such 24/32-hour shifts in these countries. In England, the shift duration limit is 13 h, and a night shift must not be preceded by a day shift (contrary to all other countries).

3.1.2. Rest breaks

Israel is the only country that requires rest hours during night shifts (see third column in Table 1, "Required Rest Time during Shift"). However, there is no effective mechanism for enforcing this directive. Other countries require residents to take short 15–45 min scheduled breaks every several hours.

Table 1 (continued)

COUNTRY	MAX SHIFT LENGTH (HOURS)	REQUIRED REST TIME DURING SHIFT (MINUTES)	MAX NIGHT SHIFTS PER MONTH	MAX WEEKLY WORKING HOURS (WWH)	NO. OF MONTHS FOR AVERAGING (WWH)	EXCEPTION TO WWH LIMIT	MAX WWH IN PRACTICE AND OPT-OUT	ENFORCEMENT	REGULATION SOURCE	REF.
Israel	26	120	6	71.5	12	ND	No opt out	limited due to inconsistent data collection Limited enforcement	Collective labor agreement + Local law	[23,53,54]
Latvia	24	ND	ND	40	ND	56 ^B	Max WWH varies significantly depending on residency specialty. In certain specialties residents may sign an opt out and the max frequently reaches 56 WWH	Limited enforcement. Violations should be reported to the State Labor Inspectorate and employer is subjected to sanctions. Employer must keep working hour records.	Collective bargaining agreement + Local law	[55,56]
Netherlands	24	15	8–9*	48	4	60	Residents may work up to 60 h per week averaged to 55 h in one month, and 48 in 4 months	Periodic audits are performed by the Inspectorate of Labor and Social Affairs	Collective labor agreement + National and sectoral laws	[57,58]
Slovenia	16	30	4	48	6	ND	Residents' agreements allow 32 h shifts	Audits by inspectors	Local labor law + Collective bargaining agreement + Residency regulation	[27]
Spain	24	15**	7	48	6	ND	Residents usually work more than 7 shifts a month	Changes in working hours are subject to approval by regional health authorities	Collective labor agreement + Local law + Regional agreements	[59–61]
US	28	ND	*10	80	1	88	Exception requires special approval of ACGME	Periodic audits are performed by the ACGME	ACGME	[24]

Notes: WWH = weekly working hours; ACGME = Accreditation Council for Graduate Medical Education; EWTD = European Work Time Directive; ND = not defined; HSE = Health and Safety Executive in England / Health Service Executive in Ireland. ^ACanada: 60-hour week is for shift work, e.g., emergency medicine. For inpatient care, the WWH limit is 80 h. ^BMaximum 56 WWH until 31.12.2021. Following legislation, maximum 48 WWH starting 01.01.2022.

* The Limit for night shifts per month is defined as once every few nights.

** A scheduled break every several hours.

*** No more than 4 consecutive nights, and 3 nights on weekends, with a 46-hour rest after 3 or 4 nights.

3.1.3. Limited monthly night shifts

Countries vary in the number of night shifts allowed per month (see fourth column in Table 1, “Max Night Shifts per Month”), which range from ten in the US to two in Hungary (where residents are allowed to work more than two if they choose to). Finland and Slovenia allow five or four night shifts per month. Canada, Netherlands, and Spain allow a relatively high number of night shifts per month (7–8, 8–9 and 7, respectively).

3.1.4. Short consecutive night shifts

The first and third columns of Table 1 show that England is the only country where residents work either day or night shifts, but never a day shift followed immediately by a night shift. Shifts longer than 13 h are not allowed in England, and once or twice a month, residents work up to four consecutive 13-hour night shifts without day shifts. Some hospitals in the US follow a similar system called “night float”, although in the US, night float shifts (of 13 h) do not entirely replace long night shifts (of 28 h). In Germany, residents work in a system similar to night float: short 12-hour day or night shifts. This system is applied mostly in wards with high workloads, such as intensive care units, and is sometimes combined with long overnight shifts comparable to the US system.

3.1.5. Limited weekly working hours

All countries analyzed in this study set a limit of weekly working hours (see fifth column in Table 1, “Max Weekly Working Hours”). In the US and Canada the limit on residents’ weekly working hours is the least stringent (80 h), which corresponds to the highest frequency of monthly overnight shifts (10 and 7–8, respectively). EU countries observe the EWTD limit of no more than 48 h. Israel falls in the middle, closer to the North American approach, with a weekly limit of 71.5 h.

In all countries, residents’ maximum weekly working hours are averaged over a certain period (see sixth column in Table 1, “No. of Months for Averaging WWH”). The reference period for averaging the maximum weekly hours ranges from one month (in Canada and the US) to 12 in the Czech Republic, Germany, and Israel. Finland and the Netherlands allow the 48 h to be averaged over a period of four months, while England, Hungary, Ireland, Slovenia, and Spain average it over six months.

Many European countries, as well as Israel, report that in practice, residents work more than the weekly maximum (see eighth column in Table 1, “Max WWH in Practice”). In some countries, such as Ireland, there is a gap between official health service statistics that show high compliance with EWTD and the actual hours worked by junior doctors as reported in surveys by medical and representative bodies, with the latter reporting hours that far exceed the official limit [29–32]. This situation continues to frustrate both sides and is likely to continue in the absence of an agreed-upon mechanism to capture accurate data.

In some countries, residents may sign opt-out agreements (England, Germany, or Finland), or alternative working contracts (Czech Republic) to exceed the EWTD limit. Germany also allows residents to work in a parallel night-shift model, with up to 12-hour shifts for high-workload departments combined with an on-call system: on-call (onsite) hours are counted and paid separately from the regular weekly work hours. This system can be implemented only in clinical areas with a lower workload, however. If residents’ work hours constantly exceed 50% of the on-call time, the ward is expected to adopt the alternative, 12-hour night-float model.

3.2. Enforcement

The ability to monitor and enforce regulations is critical for ensuring that residents’ work limits are followed in practice (see ninth column in Table 1, “Enforcement”). Ireland and England stand out in their efforts to enforce these limits [62]. Both have an orderly way of submitting violation complaints, and both have an agency responsible for compliance, the HSE (Health and Safety Executive in England and Health

Service Executive in Ireland). For example, in Ireland, hospital directors are required to complete monthly reports to the HSE regarding compliance with work directives. Nevertheless, the caveat for Ireland is that there are significant differences between Irish authorities’ reports of full compliance with the 24-hour limit for shifts and the 48-hour working week, and medical residents’ reported experience [32]. In the Czech Republic as well, there is unrealistic official reporting of residents’ work hours that does not always match work in practice. There is usually an official report about compliance with work directives submitted to the state authorities, and a parallel, unofficial report submitted to the hospital management.

In the Netherlands, Slovenia, and the US, there are periodic audits to ensure compliance. Enforcement in the US is significant, and during accreditation visits, residents are interviewed about their work hours over the past month. If violations are discovered, they may lead to a deeper investigation, increased scrutiny over time, or rarely, sanctions against the program. Finally, in Canada, there is an active residents’ union, and complaints from residents are taken very seriously.

4. Discussion

Our cross-country comparison showed that among the five strategies to reduce adverse outcomes of long working hours, the policy implemented most often is limiting weekly work hours. To the best of our knowledge, this is one of the first studies to review and compare medical residents’ working hours regulations across a broad sample of countries. There are two main approaches: the North American, which limits to 60–80 h, and the European approach that adopts the EWTD regulations and limits to 48 h per week. All countries average the weekly working hour limit over a long period of time, ranging from one to 12 months. This allows certain flexibility, as in case residents exceed the number of work hours in a certain week or month, they can work fewer hours in the following weeks, and still comply with the average limit. Yet, residents and hospitals in many European countries still find it difficult to comply with the weekly hour limit, most often due to staffing needs. Many countries have introduced opt-out mechanisms to allow residents to voluntarily exceed the work limit in exchange for extra payment.

While we compared countries with health systems with roughly similar resources, some of them are undoubtedly wealthier than others, as measured by THE as a share of GDP, public share of THE, and rates of physicians per population. Interestingly, we did not find that wealthier and less-wealthy health systems systematically differed on how they addressed the issue of resident work hours. This is counterintuitive since we would expect that for instance, Germany, with the highest number of physicians per 1000 population (4.3), to be able to shorten night shifts more easily than countries with lower rates. However, our study shows that hospitals in Germany also struggle to comply with the weekly work-hour limits. A potential explanation could be that Germany has one of the highest rates of hospital beds per capita among OECD countries (7.9 in 2020), and the highest among the countries analyzed in this study [64], meaning that the supply of hospital care is high. This suggests that workload, and not only number of residents, should be factored in when shaping a policy to reduce residents’ working hours.

Moreover, issues beyond resources play a role in residents’ work policies, including entrenched cultural norms regarding resident training. Policymakers should consider a paradigm shift on resident training and redesign their workload, allowing them to share or transfer some of the tasks and responsibilities to other health professionals such as physician assistants or nurses. For a comprehensive set of policy recommendations regarding reducing residents’ working hours, see Fig. 1.

Medical residents’ working hours have been attracting the attention of both policymakers and scholars. Meric et al. (2022) have recently published a similar study comparing pediatric residents’ working hours in several European countries [63]. Our up-to-date, comparable data extends Meric et al.’s study to other countries, which is valuable, as this

Our study raises four policy recommendations for countries seeking to reduce residents' work hours while maintaining high quality care and meeting education and training needs. Reducing shifts to 16 hours without adding workforce has adverse effects on residents' training, and may lead to a higher number of night and weekend shifts, to higher workload during shifts (work compression), and more patient handoffs, which, in turn, may increase medical errors. Handoffs have an important role in medical education and training, which may also be compromised when reducing shift lengths to 16 hours. For example, patient handoffs in the morning are often accompanied by discussions and learning opportunities with senior doctors, and residents working in other shift systems may miss out on them. These negative impacts may balance out the potential benefit to patient outcomes from residents' reduced fatigue.

To avoid these negative effects of reduced work shifts, we suggest the following steps:

1. Hospitals should add health workers to help alleviate residents' workload and relieve them from performing certain tasks that are not necessary for their training, allowing them to maximize continuity of care and learning experience during working hours.
2. Hospitals should address concerns about increased handoffs due to shortened overnight shifts to ensure continuity of care. For instance, by incorporating technology to support better handoff practices. Additionally, for service based learning to be successful, it is important to have a good rotation design with handoffs providing an effective learning experience for residents.
3. Our study found that residents in many countries do not always comply with limitations, and countries have indirect ways to allow violations of work regulations. We recommend establishing a mechanism to monitor and enforce residents' working directives, hour limits, and other regulations.
4. Policymakers should be cautious when modifying the work structure of residents and should be aware that shortening night shifts or weekly working hours may have positive outcomes, but also unintended consequences. Thus, any changes should be accompanied by ongoing evaluation.

Fig. 1. Recommendations for Policymakers.

type of data was not available previously in the published literature.

Our work is innovative in capturing complex working time dimensions with methodological triangulation and, importantly, in opening a path for future research. It would be very important to establish ways to collect objective data on actual working hours, as many countries seem to have either difficulty following their own regulation and/or discrepancies between official and unofficial reporting. The role of the COVID pandemic in justifying violations of regulated

time limits in exceptional crises should also be studied further.

4.1. Limiting residents' work hours in the US resulted in modest improvements on residents' quality of life, with unclear effects on quality of care

We found that countries limited residents' weekly work hours and length of shifts, but the effects of these limits and directives were

different in the different studies, countries and settings. Studies assessing the early effects of the 2003 policy change in the US, which limited residents' work hours to 80 per week, and limited shifts to 30 h [26,65], found that it reduced residents' fatigue and burnout [8], and improved their quality of life [66], without adversely affecting their training experience. In addition, limiting residents' work week did not adversely affect patient outcomes [40], hospital mortality and patient length of stay [67], and even resulted in fewer treatment errors [68]. Other studies have shown more modest effects of these changes on residents' well-being and a possible negative effect on residents' training [69], and patients' outcomes [4].

In a recent meta-analysis, Lin et al. found only modest positive results regarding treatment outcomes after the 2003 and 2011 ACGME duty hour regulations [69]. The authors speculated that this may be because stricter work-hour regulations and shorter shifts led to more handoffs of patients, which undermine continuity of care, and may increase errors, partially balancing out the benefits of decreased fatigue and increased quality of life after the reform [70]. Indeed, countries have implemented initiatives to support smoother handoff of patients between shifts. For example, Irish and Canadian hospitals use applications such as "The Flow" to support the transfer of care of patients from one shift to the next by making electronic medical records accessible to reading and writing notes and communicating about patients during handoff via personal mobile devices. The use of apps during handoffs has been shown to improve continuity of care, and most of the physicians who have used it report that they intend to continue with it [71].

Two randomized controlled trial studies assessed the quality-of-life and quality-of-care impacts of the ACGME 2011 regulations restricting first-year residents' shifts to 16 h, and limiting shifts for other residents to 28 h. The first focused on internal medicine residencies (iCompare study, [72,73]) and the second on general surgery residencies (FIRST study, [74]). In both, shorter shifts of 16 h, compared to 26, resulted in modest improvements in residents' quality of life, and reduced fatigue and burnout, without undermining training, but did not lead to measurable improvements in patient outcomes. In its latest position paper, ACGME decided not to shorten first-year residents' shifts from 26 to 16 h, due to the lack of any demonstrated positive impact on quality of care in the iCompare and FIRST studies [22].

A recent US study showed that shortening shifts to 16 h resulted in more treatment errors [75], contrary to previous findings [68]. In this study, the limits to working hours were not accompanied by additional workforce, leading to a "work compression" effect: residents performed the same amount of work in less time [76], which might have curbed the advantages of reducing work hours. Indeed, once the results were adjusted for workload, shorter shifts were no longer associated with increased errors [75].

4.2. Limiting the weekly work hours in Europe had mixed effects on residents' training and education

The EU EWTD amendment to include residents in the 48-hour weekly work limit was implemented differently in different countries, with mixed effects [28]. In many countries, residents can still sign opt-out documents or alternative contracts enabling them to work beyond the maximum number of hours for extra pay [1]. A recent European Commission report suggests that residents in many countries often exercise this option [77,78].

Some observational studies assessed the effects of the EU EWTD's restriction of 48 weekly hours on surgical residents' training, with mixed results. While in the UK [79,80] and Ireland [81], changes in regulations adversely impacted surgical residents' training experience (e.g., reducing time spent in the OR), this did not occur in the Netherlands [82].

In the UK, limiting the weekly working hours from 56 to 48 resulted in improvement in patient safety, measured by fewer medical errors and adverse events [83]. There, the implementation of the EWTD's directive

of reducing residents' weekly working hours was accompanied by the addition of nonphysician workers. For example, England integrated multi-specialty, nonmedical staff, such as physician assistants, nurse practitioners and phlebotomists, to take on some work traditionally performed by residents [4]. Mixing skills by adding non-physician workers was key to reducing residents' workload, which contributed to alleviating the pressures of residents, and thus to improved quality of care [84]. In Ireland, although it had been argued that unregulated work hours resulted in training benefits, these were outweighed by an "adverse cocktail" of excessive work, insufficient time for professional examinations, stress and burnout among doctors, manifesting as attrition from training schemes or emigration [50,51,85–87]. In Belgium, the EWTD regulations did not undermine training opportunities [88].

4.3. Night floats' negative effects outweigh the potential advantages

Currently, England stands out as the only country that has successfully limited residents' shifts to 13 h, by allowing short consecutive night shifts instead of day shifts. Several attempts have been made in the US and Canada to implement night float and some hospitals in the US still implement a night float system [89], alongside 28-hour shifts. However, studies have shown that the night float model adversely impacts residents' quality of life [90] and results in greater fatigue [91], less sleep [3], and increased depression [25]. Night float also negatively impacts on residents' training, as it leads to reduced attendance at lectures, less time working with senior physicians, and less time reading articles [90, 92]. In addition, in a trial period among orthopedic surgery residents in two hospitals in Canada, night-float residents' health-related reported quality of life was significantly lower compared to residents working long night shifts, and the health status of night-float residents was worse than the Canadian population, particularly regarding reported measures such as vitality, mental health, and general health. The results were so striking that both hospitals abandoned this model [2]. In another study in the US, night float was terminated mid-study due to the negative effect it had on the perceived quality of care [92].

4.4. Limitations

This study has several limitations. First, our sample of nations was limited to certain high-income countries from which experts agreed to participate in the study. This method of data collection might result in self-selection bias as not all potential countries were included in our analysis. Nevertheless, without local experts there was no way to collect precise and up-to-date data from other countries. Future research should examine additional countries.

Second, data were collected by a single person or a team of a few researchers from each country, and were not verified by national officials. Yet, the participating researchers are specialists on this topic, they collected data from official sources and published academic and gray literature. Therefore, we can assume that the data was trustworthily collected and is reliable.

Third, we have collected data at the country or state level, and cannot estimate variations in work hours in practice within a country or state or across medical specialties or types of hospitals (e.g., large/small, rural/urban, or public/private). While many countries have reported not complying with working regulations, it is hard to assess the magnitude of gaps between regulation and implementation without conducting an extensive survey of residents in each country.

Fourth, we have not compared residents' working hours to those of senior physicians to assess the extent to which residents work under harder conditions. In some countries, such as in Spain, residents work under a contract similar to senior physicians, and usually have the same workload. However, such a comparison was beyond the scope of the current work. Future studies can address this limitation and provide a more complete picture of residents' working conditions.

Finally, data was collected during the first year of COVID-19. While

residents' working hours may have changed temporarily during the pandemic, regulations have not. It is possible that working regulations have changed after the first year of the pandemic to adjust to the new needs. However, at the time of data collection, working hours regulations were those reported herein.

5. Conclusions

Despite ongoing efforts to change duty hour directives to improve residents' work conditions and quality of life, residents in the 14 countries analyzed in this study work long shifts and more hours per week than many other professionals. Attempts to reduce residents' working hours may have adverse effects on quality of care and residents' education and training. Initiatives to reduce residents' work hours, by limiting weekly work hours or shortening shifts should be accompanied by the addition of other health professionals and changing the skill mix of the medical team. This may reduce residents' workload, allowing them to focus on tasks that other professionals cannot perform, and thus avoiding "work compression" that might undermine quality of care. These initiatives should also be accompanied by an orderly handoff of patient care from one shift to the next to ensure continuity of care, as well as by efforts to ensure the quality of residents' education and training. Striking the optimal work-training balance for residents is a dilemma faced by many countries and may be solved by a joint effort at the international level, benefitting from multiple countries' experiences. In addition, policymakers will have to be increasingly aware of residents' need for work-life balance, which has various implications for their work, including choice of specialty [93,94] and burnout [95].

Our study serves as a "menu of options", supported by real-world evidence for policymakers willing to make informed decisions to improve residents' working conditions in their countries. Nevertheless, it is important to tailor the regulations, measures, and reforms to each country's context and culture.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.healthpol.2023.104753](https://doi.org/10.1016/j.healthpol.2023.104753).

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