

APPENDIX A **POTENTIAL COST IMPLICATIONS OF CHANGES TO RESIDENT DUTY HOURS AND RELATED CHANGES TO THE TRAINING ENVIRONMENT**

TERYL NUCKOLS, MD, MSHS
JOSÉ J. ESCARCE, MD, PhD

Executive Summary

The principal objective of this analysis was to estimate the potential direct costs of changes to resident duty hours and the training environment planned by the Accreditation Council for Graduate Medical Education. A secondary objective was to estimate the net costs at major teaching hospitals, that is, costs incurred after accounting for any savings that might occur through reductions in preventable adverse events (injuries due to medical errors).

To estimate the direct costs of the planned changes, we first reviewed recent literature pertaining to duty hours. Next, we examined the ACGME's revised Common Program Requirements and selected requirements for inclusion in the cost analysis, based on 2 criteria: (1) the requirement appears to differ from practices in most residency programs today and (2) the requirement would generate quantifiable costs. The planned changes that met these criteria included a maximum shift duration of 16 hours for PGY-1 residents, a maximum shift duration of 28 hours for specialty and subspecialty residents above the PGY-1 year, several requirements to educate residents and faculty members about fatigue and safety issues, the requirement for standardized procedures for handing over patient care, the requirement that programs offer sleep facilities or transportation after residents have overnight shifts, and the requirement for annual site visits by the ACGME to assess the implementation of the planned changes.

We estimated costs by determining the resources involved in adhering to each of the planned changes and then multiplying by the cost per unit of each resource. To determine the cost of the planned changes to duty hours, we considered residents' baseline working patterns, the hours of work that they would transfer to other providers after the planned changes are implemented, and the cost of the other providers per hour. In our base-case analysis, we made several important assumptions pertaining to the extended shift requirements:

1. PGY residents at small programs would transfer 14 or more hours of work per extended shift to a mixture of attending physicians and nurses;
2. PGY-1 residents at larger programs would continue to work the same number of hours as they do now through a reorganization of those hours rather than a transfer of hours to other providers;
3. Specialty residents above the PGY-1 year would transfer 2 or more hours of work per extended shift to other specialty residents; and
4. Subspecialty residents would transfer 2 or more hours of work per extended shift to attending physicians.

These assumptions were based on how the ACGME anticipates that the reforms will be implemented. One set of sensitivity analyses examined the effect of uncertainty in model parameters. A second set of sensitivity analyses examined the effect of uncertainty in how the changes might be implemented, such as whether more residents would need to transfer work to alternative providers, or whether alternative types of substitutes might be used.

Teryl Nuckols, MD, MSHS, is Visiting Assistant Professor and José J. Escarce, MD, PhD, is Professor in the Division of General Internal Medicine and Health Services Research, David Geffen School of Medicine, University of California at Los Angeles.

For the cost of the planned changes to the training environment, little published literature was available. Consequently, we made assumptions about resource use in conjunction with ACGME representatives and then obtained published estimates of the cost per unit of each resource.

We found that the total direct annual cost of the planned changes (including both recurring costs and amortized start-up costs) would be \$380 766 262 nationwide (in 2008 dollars). In the sensitivity analysis reflecting uncertainty in model parameters, such as the frequency of extended shifts and the number of weeks with extended shifts, total direct annual costs ranged from \$226 463 205 to \$694 274 461.

Uncertainty in how the reforms may be implemented had a much greater effect on the cost estimates. If all PGY-1 residents transferred work to a mixture of attending physicians and nurses, the cost would reach \$1 187 014 278. If only PGY-1 residents at small programs transfer work, but all other work beyond the current extended shift limits is transferred to substitute providers, the cost would be \$817 388 224 when using all attending physicians; \$561 769 401 when using all midlevel practitioners; and \$335 141 689 to \$739 503 992 when using an expanded population of residents (depending on whether the cost of hiring additional residents is based on wages and benefits or on average per resident expenditures on graduate medical education from all sources, respectively). The efficiency of the substitutes relative to the residents whose work they are assuming is another factor that could affect the cost.

To estimate net costs at major teaching hospitals (defined as members of the Council of Teaching Hospitals), we developed a probability model representing direct costs as well as costs associated with preventable adverse events. The model simulated hypothetical changes in preventable adverse events, ranging from a 10%

increase to a 10% decrease. We considered this range because reductions in fatigue, improved handover procedures, and other changes could reduce preventable adverse events, but the effect of the planned changes on preventable adverse events is not yet known and, if discontinuities of care rise, preventable adverse events might also. Two different versions of the model represented the hospital and societal perspectives; the teaching-hospital version included event costs that are absorbed by hospitals, whereas the societal version included all preventable adverse event costs. Both versions included the portion of the total direct annual costs associated with residents' training at major teaching hospitals (members of the Council of Teaching Hospitals). We found that, under the base-case analysis assumptions pertaining to direct annual costs, the revised policy would be cost saving for society if it reduced preventable adverse events by 2.4%, and cost-saving for major teaching hospitals if it reduced preventable adverse events by 10.9%. If the direct annual costs are higher, greater reductions in preventable adverse events would be required for the change to be cost saving from both the major-teaching-hospital and societal perspectives.

This analysis has several limitations, including the fact that data on the baseline working patterns of residents are somewhat sparse and data relevant to the resources and costs associated with the planned changes to the training environment are minimal. Our methods of estimating costs may yield different results from the expenditures that programs ultimately incur when hiring other providers or additional residents because programs may implement the changes in a manner that differs from what the ACGME anticipates. However, we addressed limitations to available data through the use of numerous sensitivity analyses, which offer insight into the effect of model parameters on the direct annual costs.