

In Conversation With... Christopher P. Landrigan, MD, MPH

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Editor's note: *Christopher P. Landrigan, MD, is Associate Professor of Medicine and Pediatrics at Harvard Medical School and Director of the Sleep and Patient Safety Program at Brigham and Women's Hospital. His research on strategies to mitigate fatigue to improve patient safety has influenced the Accreditation Council on Graduate Medical Education's (ACGME) policies related to duty hours and supervision. We asked him to update us on sleep deprivation and duty hours.*

Dr. Robert Wachter, Editor, AHRQ WebM&M: Tell us how your thinking about duty hours and patient safety has evolved over the last several years.

Dr. Christopher P. Landrigan: I began working about 12 years ago on the issue of duty hours and sleep deprivation as it affects patient safety, in large measure because of some of my own experiences as a resident during an era when there were no duty hours [regulations]. We looked at medical errors through an initial randomized [trial](#) in which interns on their two ICU rotations spent one of them on a traditional schedule and one on a schedule limiting them to no more than 16 consecutive hours of work. We found that when we cut the hours, the rates of serious medical errors dropped off substantially.

In terms of how my thinking has changed, for one thing, we know a lot more now than we did 10 years ago about the effects of sleep deprivation on performance. A series of relatively small studies has been done by programs that implemented these types of changes and looked at what happened when they did it. Those experiments have been largely successful. The science behind none of them is perfect. But the overall message is that when these types of interventions are put in place, indicators of quality or safety seem to get better. Residents report that their quality of life tends to improve and ratings of education have remained more or less constant. In the experience of those early adopters that started to make these changes in earnest, it seems like it can be done successfully.

RW: In part because of work that you've done, we have national policies on duty hours. The narrative out there seems to say these policies made sense given the literature about the effects of sleep deprivation, but they haven't worked as intended and may even have had some unanticipated consequences. What do

you think?

CL: It's obviously still an ongoing question. The first real policy change in 2003 limited the hours substantially in only a couple of specialties. In surgery and some surgical specialties where weekly work hours were not infrequently over 100 hours a week, an 80-hour workweek was a relatively substantive change. But in pediatrics, internal medicine, and family practice, it represented more of a minor rearrangement in hours than a revolutionary change. As a consequence, the finding that these types of changes didn't lead to huge improvements is not surprising, because there simply wasn't much change in work hours or sleep. In our work looking at the actual effects of these types of changes on work hours and sleep, we found that work hours dropped by only about 5% after implementation of the 2003 duty hour standards. Sleep on average improved by only 6%. So with those types of very modest changes in work and sleep hours, you wouldn't expect massive changes in patient safety.

That said, the changes implemented more recently are pretty substantive, at least with respect to the interns. As of 2011, in [response](#) to both the Institute of Medicine [report](#) as well as its own internal review process, the ACGME decided that interns would not work for more than 16 hours in a row. Total weekly work hours remain at 80, but the simple introduction of that shift limit leads to some profound consequences for traditional call schedules for the interns. Whether in fact that leads to real improvements or not is still an open question.

RW: As you think about both the tradeoffs and potential collateral challenges, can you envision a system that delivers most of the benefits of duty hour reductions and a more shift-oriented schedule without what most people perceive as potential harms around shift work mentality, handoffs, and training volume? Is there a way of having your cake and eating it—or at least not choking on it—too?

CL: You're hitting on what I think is the key issue. For a long time, the simplistic view has been that long working hours may generate fatigue-related errors, but you can't address this problem without shortening hours, which will cause more changes of shifts that will lead to disrupted handoffs and inevitably more handoff errors. In other words, damned if you do and damned if you don't—there's no solution. In my view, this thinking is wrong. The trick is to implement changes in work hours in concert with concentrated efforts to improve the handoff process, teamwork, and infrastructure. Doing so can address fatigue-related errors without necessarily leading to a substantial increase in handoff errors. The net result can indeed be one where fatigue-related errors are reduced and handoff errors are not increased either.

RW: The objections one hears about trainees not getting enough clinical experience often come from surgical specialties. The point has been made that shifts work fine in environments like the ED or ICU where in some ways that's the flow of the work anyway. It all raises the question whether a single set of regulations for all trainees may not be the right way to fix this. As you think about optimizing, does a one-size-fits-all solution work?

CL: I have a couple of thoughts about that. First, with respect to work hours, sleep deprivation, and trying to address fatigue-related errors, the fundamental mechanism by which fatigue-related errors occurs is human biology. While there certainly is some individual variation in how much sleep one of us may need compared to the next, that variation is not driven by a difference in specialty or a difference in a particular

task. We know that surgeons suffer from fatigue-related errors, as do medical residents. From that perspective, I think it's difficult to justify this idea that limits shouldn't apply to one group or another because it's more difficult or because the nature of the task differs.

That said, the precise, optimal work schedule for each of those groups will differ. Insofar as a particular residency program or a particular group of workers is adhering to best practices with respect to sleep and circadian scheduling, a number of solutions can work. And you have to pick the one that seems like it will be most conducive to workflow. In addition, some of the infrastructural elements needed to surround those work hours changes are hugely different depending on the type of work. For example, if you think about just the issue of handoffs, the size and complexity of patients on medical services versus surgical services versus pediatric services vary quite a bit. While some common structures can be potentially used across all of those types of handoffs and groups of individuals to facilitate things, exactly how they're implemented very much have to be tailored to the specialty.

RW: Can you talk a little bit about napping and other strategies that may impact a given program or policymakers as they try to figure out the next iteration?

CL: A lot of industries have implemented nap programs as one aspect of a comprehensive approach to dealing with fatigue in the workplace. In the middle of the biologic night at the circadian nadir, most of us are a little bit more tired and more prone to making mistakes as a consequence of fatigue. In that context, the use of strategic napping—even relatively short naps of 20–30 minutes or sometimes longer—can be beneficial for the remainder of that shift. In specialties with a robust enough workforce that can afford for that to happen, it's a hugely beneficial thing to do. At least it would appear to be by analogy with other industries. Testing it in medicine has been relatively limited, but a couple of studies now have shown as long as you can get residents to take naps, it's a pretty effective solution in our field as well. But I would caution against using a nap strategy in the absence of anything else. If someone continues to work a traditional 30-hour shift, but then has 30-minute nap in the middle of it, the benefits of it are going to be relatively limited in terms of improving fatigue-related performance.

RW: What have we come to understand about what happens to residents when they are "off"?

CL: Having a reasonable fatigue mitigation policy in place requires as a first step that there are reasonable work hours and that the design of the schedules themselves is conducive to sleeping well and getting rested. But part of the responsibility clearly rests with the individuals themselves too. There is no way to enforce someone sleeping just because they are provided with time off work. We have to recognize the science that tells us that being up for 24 hours in a row is more or less the equivalent of being legally drunk in terms of reaction time and a number of types of judgment performance tasks. Just as we would expect our colleagues not to show up to work drunk, we should expect them to show up to work well rested. That gets tough for people given the exigencies of life, the constraints of balancing family and work, and trying to deal with all the other things that are part and parcel of residency like missed social opportunities and difficulties seeing friends. But it really is important. The good news is that I think there has been a gradual evolution over the past 5 or 10 years of residents beginning to take this issue more seriously.

RW: As more and more programs have to incorporate night shifts and night floats of one sort or another, for resident coverage and now increasingly for attending coverage, what have we learned about how people work at night in terms of how many days in a row you should do night shifts and how much time it takes to reset your clock?

CL: There is a fair amount of information on this from other industries. In medicine so far there is still relatively little. When working a shift system, the first night shift can be hazardous if someone is flipping from days to nights and wakes up that morning at their regular awakening time. Let's imagine that it's 6:30 in the morning for a particular resident who's about to flip to the night shift. That person wakes up at 6:30 in the morning, is up all day, and then works the night shift. From the standpoint of their circadian and homeostatic sleep systems, and therefore from the standpoint of the risk of fatigue-related error, they may as well have been at work the entire time. Their body is not really differentiating between what they were doing in those hours through the day. So it's really important in that first day to try to sleep in as late as possible in the morning, and if at all possible to take a nap in the afternoon before coming into a night shift, which has been shown again and again to mitigate the effects of fatigue-related error that night.

Beyond that, in terms of the pattern of how many nights in a row to work, there's pretty clear evidence from other industries that once an individual hits 3 or 4 nights in a row, the risk of error begins increasing substantially. The reason is that adjusting one's circadian clock (as you would if you were flying to Australia or to Tokyo) takes quite a bit of time. Working 4 or 5 nights in a row on a night float system is not long enough to make a 12-hour circadian shift in most cases. Therefore, after each successive night shift, we get a little bit more fatigued because of misalignment from a circadian standpoint, which adversely affects performance at night and also leads to us not sleeping that well during the day. The resulting buildup of chronic sleep deprivation has a synergistic interaction with the circadian misalignment and things tend to get worse and worse as the days go on.

One of the most common pieces of advice from other industries is to try to keep the number of nights in a row to a minimum. People debate about whether the limit should be 3 nights, 4 nights, or 6 nights. Certainly in medicine we don't have clear data on what is optimal. But once you start passing that 3- to 6-night range, things are going to get worse, and the risk of error goes up quite a bit. The alternative approach to this type of a night float, in a system where you're flipping from days to nights, is to do something that we have tended to advocate, the idea of a rapid cycle rotation system. You can imagine it like a Q4 schedule, but on the on-call day, rather than showing up at 8:00 in the morning, one shows up at 8:00 at night. That way you are cycling in and out of days and nights as part of the primary team, but it is only one night in a row and then a day off after that in order to recover.

RW: What do you think about the policies ACGME has put in place the past 8 years?

CL: Well, the ACGME certainly had it right that this is a complicated thing to do and that you can't just think about work hours. You have to think about all of the elements that surround work hours as well: handoffs, supervision, and resident workload. You have to think about how to redesign the learning environment for residents to make sure that they get the training that they need. There were pretty compelling data pushing the ACGME towards doing something with the interns. The choice they made of limiting interns' shifts to no more than 16 hours in a row makes a lot of sense based on the evidence, though biologically, it is hard to

defend the notion not to limit work shifts for second- and third-year and more senior residents if you believe that fatigue is having an impact on interns. Their biology is no different than the interns', and the types of work in which they are engaged is really not that different.

One of the major rationales for leaving senior residents' traditional 28-plus hour shifts intact was the idea that we need to train these residents to deal with long shifts because once they finish training and become attending physicians they are going to have to work them anyway. So they need to learn how to do it. But there are two problems with that argument. The first is that there is no evidence at all that one can learn to tolerate the effects of sleep deprivation by repeated exposure. In fact, quite the contrary, it is pretty clear that if you are chronically sleep deprived when going into a bout of acute sleep deprivation, the aggregate effects of those two things together is far worse than the acute bout of sleep deprivation all by itself. And it does not appear that senior physicians, senior nurses, or senior folks in other industries for that matter are any more resistant to the effects of sleep deprivation in general than are the interns. The second problem is that realistically when you look at workforce trends in the United States, with the exception of a couple of the more procedure-intensive specialties, most attending physicians don't work the kind of hours that residents are working anyway. So the notion that somehow they need to be prepared for this doesn't quite hold water in my mind.

RW: So would you advocate extending what was done for the interns to all residents?

CL: Ultimately, I think that is where things will need to go, but there are a lot of workforce and cost implications to doing that and ongoing questions about how best to make this transition. We need data on how best to limit resident fatigue and what types of systems will be most effective. We need to think about how it will be financed. At this point the data are clear that shift limits needed to occur for the interns. The data are far less compelling for more senior residents at this point in time, but it would be a shock if the same kind of forces are not found to be at play with the more senior residents as with the interns. The reason I believe the effects are likely to be the same is that all of the preliminary data—for example, cohort studies that have looked at the effects of sleep deprivation on senior residents—find the same effects that have now been well demonstrated in the interns. Some initial studies looking at senior attending physicians are also finding the same types of effects.

RW: Can I assume that you favor similar kinds of restrictions for practicing physicians?

CL: Putting any type of restriction in place for senior physicians is really difficult for a host of pragmatic reasons. I don't know that things will go that way here in the US. From a safety standpoint, it wouldn't be an irrational thing to do based on the existing data, but lots of pragmatic difficulties arise in doing so. That said, other countries have limited senior doctors' shift duration. Europe, for example, has put work hour regulations in place both for senior physicians as well as for trainees with the passage of the [European Working Time Directive](#). While certainly not enforced in some of the European Union countries, in others it is enforced quite seriously. It really has changed the way that medicine is practiced in those countries. Other countries, like New Zealand, years ago implemented resident work hours. They never did anything with respect to enforcing changes for the attending physicians. But since New Zealand passed its resident regulations in the 1980s, as those residents moved on into practice themselves, they didn't want to start working the types of hours that their predecessors worked. So gradually the entire system has changed

such that the types of long hours that are common here in the States are fairly rare in New Zealand, even without any type of regulation of attending physicians. My suspicion would be that in the States things are more likely to go that way than mandated work hours for senior doctors, but we'll see.

RW: You led a now famous [study](#) that demonstrated no change in at least one way of measuring patient safety over the course of a 5- or 6-year time horizon. Tell us about that and whether those findings surprised you and how you've made sense of them.

CL: The North Carolina Study was not a study of the effects of changes to resident work hours, but was rather an attempt to understand what the net effects of all efforts to improve patient safety have been over time. We did two things in the North Carolina study. We applied the Institute for Healthcare Improvement's [Global Trigger Tool](#) to a random selection of patients and a random subset of hospitals throughout North Carolina to try to understand whether the tool could be used as a reliable systemic surveillance method to look at rates of medical errors and patient safety generally. We were also trying to understand whether things were improving over that 6-year span, particularly in North Carolina because the state had been pretty engaged in the patient safety movement and had a very active statewide hospital association that was really invested in trying to fix things.

We found that, first of all, the tool itself worked quite well. It was very reliable both at the level of the initial review by hospital-based reviewers as well as at the secondary analysis stage, where a couple of physicians review the results of anything picked up on primary screening. Disappointingly, we found that rates of harm due to medical care were not improving over the 6-year span that we evaluated—which was a little bit surprising, frankly. We were expecting that we would see at least some inching in the right direction and we really did not.

RW: If you repeated the study today do you think you'd find the same thing?

CL: My suspicion is that we might be seeing the beginnings of improvement now, as the patient safety field has begun to make measurable inroads in some areas, such as reducing hospital-acquired infections and surgical complications. However, there are still many other areas within patient safety where there has not yet been tremendous progress. For example, if you think about computerized order entry systems, even though 20 years of data suggest that those types of systems are effective in reducing medication errors and adverse drug events, according to the most recent systematic reviews, a fairly small minority of hospitals nationwide had implemented those systems. With slow implementation and poor uptake of some of these interventions and poor coordination across sites, it's difficult to make measurable regional or national change. Likewise, in terms of improving teamwork and handoffs and implementing work hour changes, while there has been the beginning of some national movement, particularly with work hours limits now for interns, a lot of these systemic interventions have not really been well adopted across institutions. So when you try to look at a very high level at whether we're making inroads in patient safety, progress has been limited.

RW: Obviously the data are the data and you reported them fairly. Do you worry about policymakers in Washington who have allocated hundreds of millions or billions of dollars for safety—if the needle hasn't moved, I guess they could say we need to do more and better, or we need to do less because it's not

working. Do you worry about the latter possibility?

CL: Oh sure, absolutely. In my mind it's pretty clear that the answer is: we need to do more and better. It's easy to document the places where we have been successful. When there have been focused efforts in particular arenas, certainly catheter-related bloodstream infections and surgical complication rates, there's been tremendous progress. In my mind those lessons should be incentive for all of us to try to extend safety improvement efforts to other realms within the hospital, where we see a host of patient safety problems that have not yet been adequately addressed. Improving patient safety throughout the hospital is entirely possible, but it will require a sustained focus over a long time to fix the many broken parts of our complex health care systems.