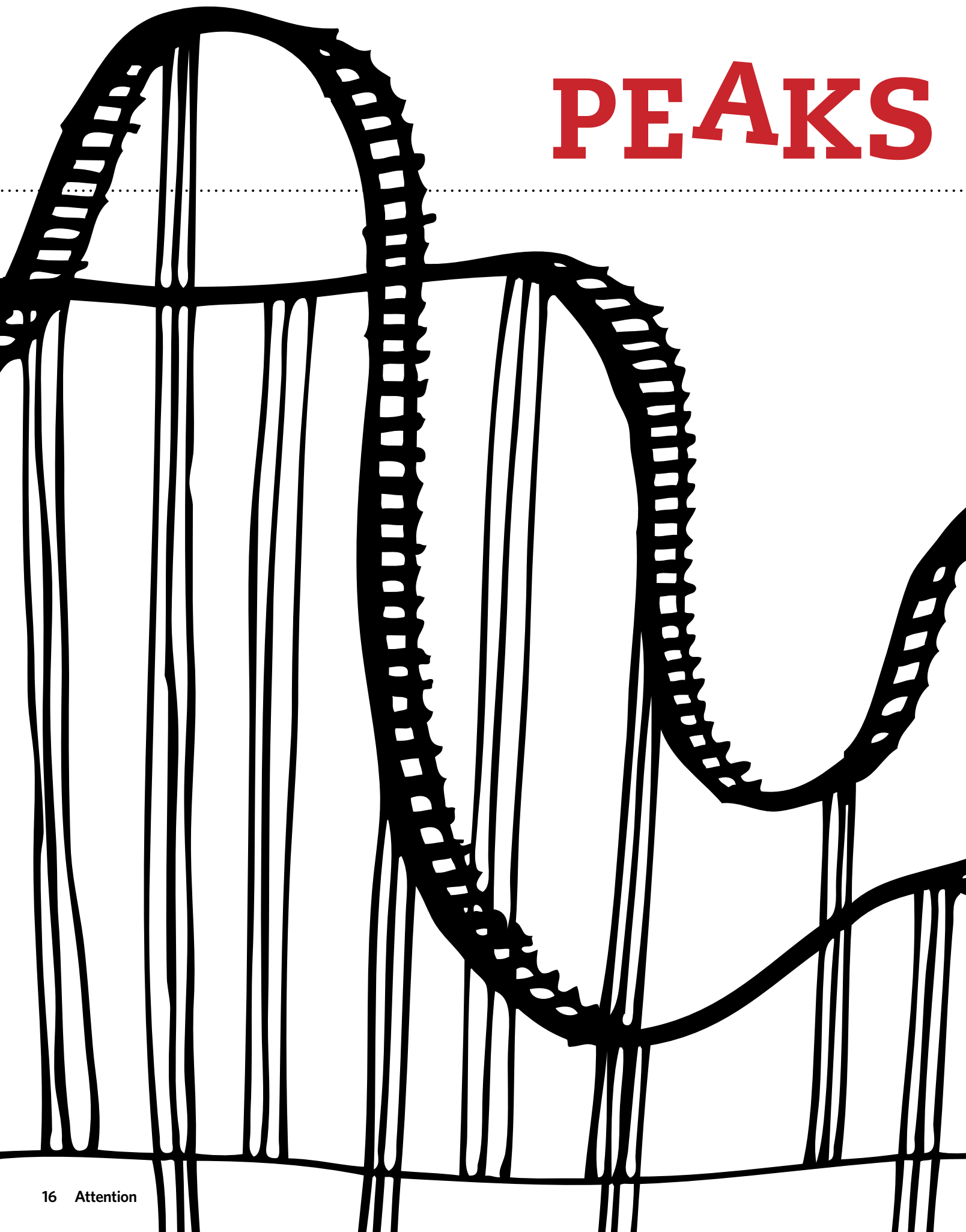


# PEAKS

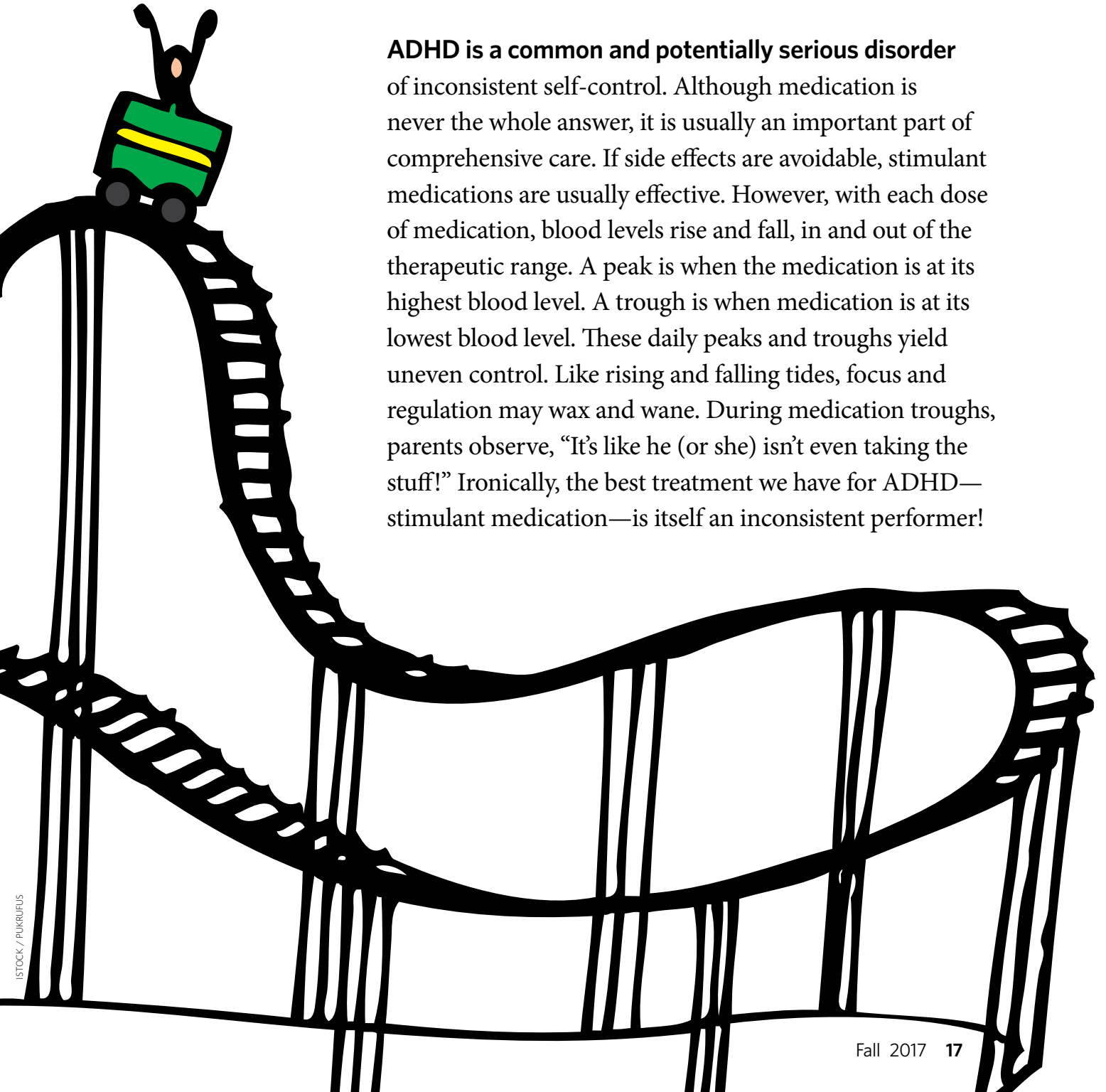


# AND TROUGHS

## Uneven Medication Coverage & ADHD

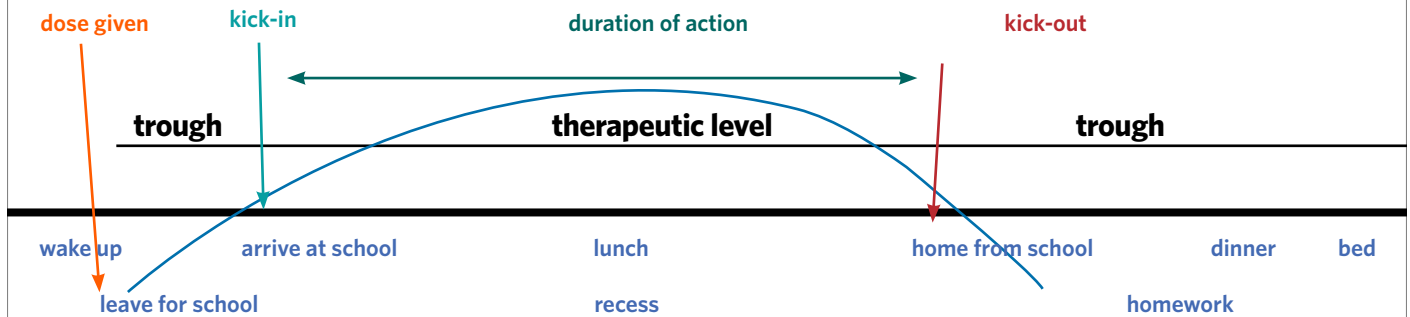
by Dan Shapiro, MD

**ADHD is a common and potentially serious disorder** of inconsistent self-control. Although medication is never the whole answer, it is usually an important part of comprehensive care. If side effects are avoidable, stimulant medications are usually effective. However, with each dose of medication, blood levels rise and fall, in and out of the therapeutic range. A peak is when the medication is at its highest blood level. A trough is when medication is at its lowest blood level. These daily peaks and troughs yield uneven control. Like rising and falling tides, focus and regulation may wax and wane. During medication troughs, parents observe, “It’s like he (or she) isn’t even taking the stuff!” Ironically, the best treatment we have for ADHD—stimulant medication—is itself an inconsistent performer!



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## Daily Coverage Curve



### Trough-filling failure

Many children do just fine with a single dose of long-acting medication. But for many others, a prescriber's failure to identify and fill troughs in medication coverage can cause all sorts of problems. At school, stimulants may kick in too late or kick out too early. This leaves the first and last periods of the day inadequately protected. Children with rapid metabolism might burn through their medicine too quickly. Consequently, "long-acting" medication might not last through the school day; sometimes, not even until lunch.

At home, medication usually isn't on board in time to help with the morning routine. After school, medication may wear off before homework or tutoring. Moreover, undertreated ADHD is not just a threat to academic success. Medication troughs may also compromise extracurricular, leisure, social, and family activities. There are safety issues too. For teenagers, failure to cover ADHD after school and into the evening can result in serious problems with distracted driving and impulsive misadventure. Undertreated ADHD is also an underappreciated cause of sleep problems.

"Trough blindness" occurs when parents, teachers, prescribers, and children do not make the connection between low medication blood levels and poor ADHD control. "Trough-filling failure" represents a missed opportunity to maintain optimal ADHD control across all important tasks, activities, and settings.

### Tiffs from TFFs

Trough-filling failures can lead to all kinds of misunderstandings; or, if you will, TFFs can cause tiffs!

- **TFFs and "Parent (or Partner) Deficit Disorder"**

Medication troughs—in the early morning, late after-

noon, and evening—can lead parents to blame each other or themselves. *Why does Timmy do better at school with his teachers or with my spouse (for mid-day activities) than with me (at the beginning and end of the day)?* Other trough-blind adults, like friends or grandparents, might get in on assigning blame, shame, and guilt.

- **TFFs and "Teacher Deficit Disorder"**

Uneven medication coverage through the school day can lead teachers to blame each other or themselves. *Why does Timmy do so well with Ms. Smith in the morning but so poorly with Ms. Jones in the afternoon?* Trough-blind parents or principals might also make wrong assumptions about the competence of individual teachers.

- **TFFs and "Child Deficit Disorder"**

Medication troughs can lead adults to draw wrong conclusions about a child's potential. Similarly, a child might mistake their own undertreated ADHD for inability and develop an inappropriately pessimistic self-image. Uneven medication coverage can make relatively mild skill deficits seem like insurmountable disabilities. If only troughs were filled, the child would not seem so cyclically "incapable," "lazy," or "oppositional-defiant."

### Trough tracking

Phase one of a stimulant trial is about determining the best medication and the best dose. Phase two is about fine-tuning that medication to maximize benefits and minimize side effects. This requires active investigation for possible treatment troughs. Trough tracking is as simple as looking for regular kick-in and kick-out times.

- What time do you take/give the medication?
- How long does it take to kick in?
- How long does it take to kick out?
- What's the time between kick-in and kick-out; that is, the duration of action?

For some children, kick-in, kick-out, and duration of action are unclear. If in doubt, assume that regularly occurring peaks and troughs in self-control or performance are probably due to changes in medication blood level. Draw a daily coverage curve to show peaks and troughs for different times of day, tasks, and activities.

On the Daily Coverage Curve above, notice that Timmy has a therapeutic level of medicine by the time he gets to school. It lasts throughout the school day. His teachers report excellent ADHD control: "A model citizen!" His parents wonder if the teachers are describing somebody else's kid. For them, every morning before school is "a disaster." He won't get dressed, sit for breakfast, brush his teeth, or get his backpack. Despite their constant prodding, Timmy is late for school more times than not. After school, he seems to be itching for a fight with his sister. And good luck trying to get him to do his homework. He won't stay at the dinner table or get ready for bed. He won't wind down for sleep. He's in and out of his room until late at night. Timmy also takes his medicine on weekends and the same pattern holds true. He does great playing by himself in the late morning and for baseball in the early afternoon but, "he's like a different kid," at the beginning and the end of the day.

### It's trough-filling time!

For the sake of this discussion, let's assume that everyone has done the best they can with nonpharmacologic management. But pretty good behavioral, emotional, educational, and collaborative problem-solving strategies are clearly not enough. To fill treatment troughs, better medication coverage is truly necessary.

#### Early morning troughs

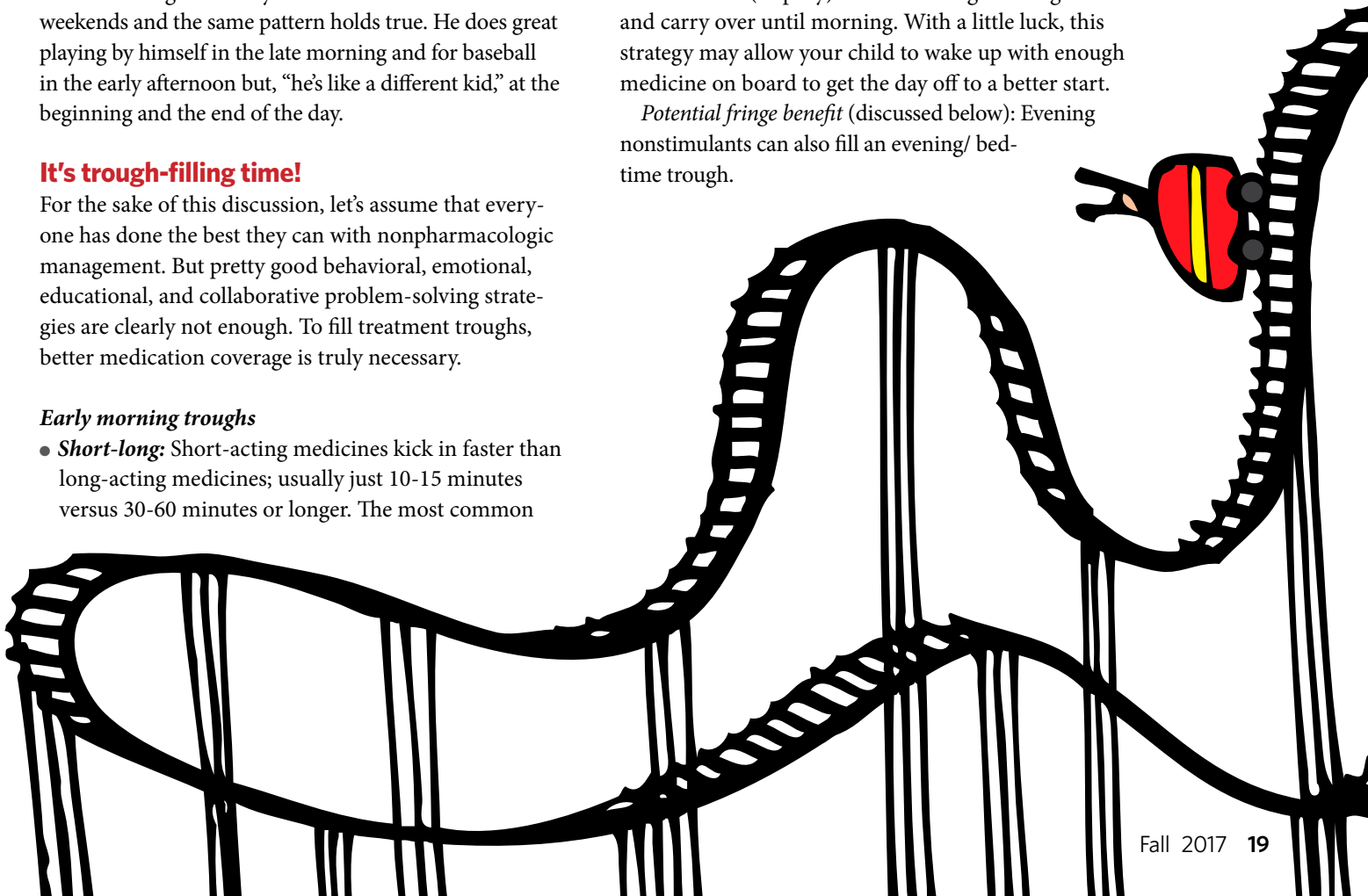
- **Short-long:** Short-acting medicines kick in faster than long-acting medicines; usually just 10-15 minutes versus 30-60 minutes or longer. The most common

maneuver for filling early morning troughs is simply giving short-acting stimulant immediately upon waking; perhaps, when your child is still in bed with only one eye open. Before starting the morning routine, deliberately wait 15 minutes or so for the jump-starting dose to kick in. If necessary, move breakfast earlier in the routine to minimize appetite suppression. Wait to give the long-acting stimulant until just before your child leaves the house. This gives the short-acting stimulant some time to start kicking out before the long-acting stimulant starts kicking in. If there's not enough time (between waking up and going to school) to avoid too much overlap between doses, then the long-acting stimulant can be administered at a more optimal time by the nurse at school.

*Potential fringe benefit* (discussed below): This short-long morning stimulant strategy might also fill an afternoon trough and avoid the need to give an after-school dose.

- **Nighttime nonstimulants:** Although not usually as effective, nonstimulant ADHD medications can work well enough, and they usually have a much longer duration of action. Sometimes, a before bed dose of atomoxetine (Strattera), guanfacine-ER (Intuniv) or clonidine-ER (Kapvay) can last through the night and carry over until morning. With a little luck, this strategy may allow your child to wake up with enough medicine on board to get the day off to a better start.

*Potential fringe benefit* (discussed below): Evening nonstimulants can also fill an evening/bed-time trough.



- **New delayed-release stimulant:** A potential game-changer is coming soon. A new controlled-release medication, taken in the evening, is designed to provide therapeutic levels beginning in the early morning and lasting through the day. Sundown dosing. Sunrise kick-in.

### Afternoon, after-school, and early evening troughs

- **Long-short:** It's not unusual for long-acting medications to kick out on arrival home from school. Your child might just need a few more hours of coverage. Commonly served with an after-school snack, a well-timed boost of short-acting medicine can provide an additional 3-4 hours of therapeutic blood level. This may be enough to get through homework, chores or other after school activities.

*Potential fringe benefit:* Work done. The evening is free to relax.

- **Long-long:** If your child is a rapid metabolizer, the morning dose of long-acting stimulant plus an afternoon dose of short-acting stimulant may not add up to provide sufficient duration of coverage. The long-acting dose in the morning may not last through the school day. The short-acting dose after school may not last through homework. Either way, you might want to try long-acting medication twice each day. Let's say the 7:30 AM dose kicks in by 8:30 AM but starts to kick-out around 1:30 PM. That means a one-hour kick-in time and six hours for duration of action. Knowing that, a second 12:30 PM dose of long-acting stimulant would kick-in by 1:30 PM and last until about 7:30 PM. Perfect!

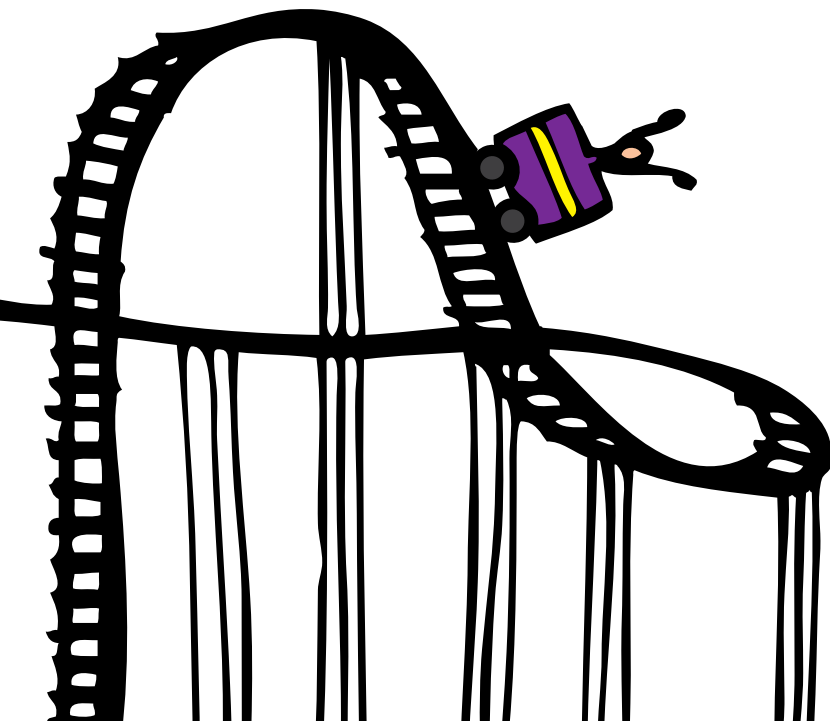
*Potential fringe benefit:* Again, work done, evening to relax. Plus, there is no need to give a dose of medication after school. This is handy if your child has important after-school activities but cannot take medication; either because he or she is out and about, or because you are at work and there's no one else to safely take care of administration.

- **Nonstimulant:** Let's say you try either the long-short or long-long strategies above and achieve longer duration of action. However, the second dose of stimulant causes too much appetite suppression or insomnia. With luck, nonstimulant medication (atomoxetine, guanfacine, or clonidine) can work well enough and avoid these side effects. If you find (during phase one of a trial) that a nonstimulant works, then you can experiment with the best timing to optimize coverage. Nonstimulants can be given in the morning, afternoon, or evening; once or twice daily. Usually, nonstimulants are most effectively combined with stimulants. However, if your child has an excellent response, you can try the nonstimulant alone. Either way, compared to stimulants, nonstimulants usually establish much more even blood levels without the same kind of peaks and troughs.

*Potential fringe benefit:* Nonstimulant medication is not just helpful for filling troughs. These medications can augment or boost the effectiveness of stimulant medications throughout the day. This is especially helpful if the maximum tolerated dose of stimulant medication does not achieve optimal control even at peak blood levels.

### Bedtime trough

- **Short-sheeting:** Remember how there were always just a few kids at summer camp who got short-sheeted and—much to everyone's surprise—they seemed to fall asleep better! Everybody knows that stimulant medication can cause insomnia. But undertreated ADHD can cause insomnia, too. If a bed time trough of distractibility, hyperactivity, and impulsivity are the source of the problem with settling to sleep, then short-acting stimulant can be the answer. Sometimes, insomnia is amplified by medication kick-out "rebound"; in other words, a stimulant deficit, not a stimulant excess. In one controlled study of children with ADHD and insomnia, a prebedtime dose of short-acting stimulant made insomnia worse in about 1/3, no different in 1/3, but substantially better in another 1/3. Worth a try—but first, on a Friday or Saturday night where



no important weekend activities are planned! Until you try, you never know which third you're in.

- **Nonstimulant:** Of the nonstimulants, clonidine is usually the most sedating. The dose given for ADHD-driven insomnia is a bit higher and closer to bedtime than the dose given for wake-time treatment of ADHD. If too much sedation is a problem, then try a lower dose, give it later, or try one of the other nonstimulants. Optimal timing is crucial. Possible problem: Evening guanfacine or clonidine can wear off in the wee hours of the morning and cause rebound night-waking.

*Possible fringe benefit:* Not just better sleep onset but better sleep maintenance. Plus (as discussed above), carry over to early morning trough-filling.

As with all treatment for ADHD, trough-filling strategies should only be done on a trial basis and with carefully individualized outcome measures. Whatever trough-filling strategy you try, make sure to obtain baseline and follow-up ratings from people who observe your child during that trough time. Of course, whenever possible, your child should be an active participant and observer in their own treatment trial.

### To fill or not to fill?

Some children really need good ADHD control from stem to stern. To fill all troughs, a combination of strategies may be appropriate: short-long-short or long-long-short stimulant medication, possibly combined with once or twice daily nonstimulant medication. But some troughs are desirable and we should deliberately leave them unfilled. Strategically, doses can be timed and troughs created to minimize undesirable side effects; for example, at mealtimes or sleep times. Some children and adolescents want to be free of medication effects for activities where lack of inhibition may be desirable; such as, theater, music, or other creative arts; athletics; or certain social situations. In this way, trough management can be done effectively, collaboratively, and respectfully. After all, you can lead a horse with ADHD to the water trough, but you can't make him or her drink. 🐾

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