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SPECIAL INVESTIGATION

HOW YOUR HEALTH RECORDS BECAME A HEALTH CRISIS

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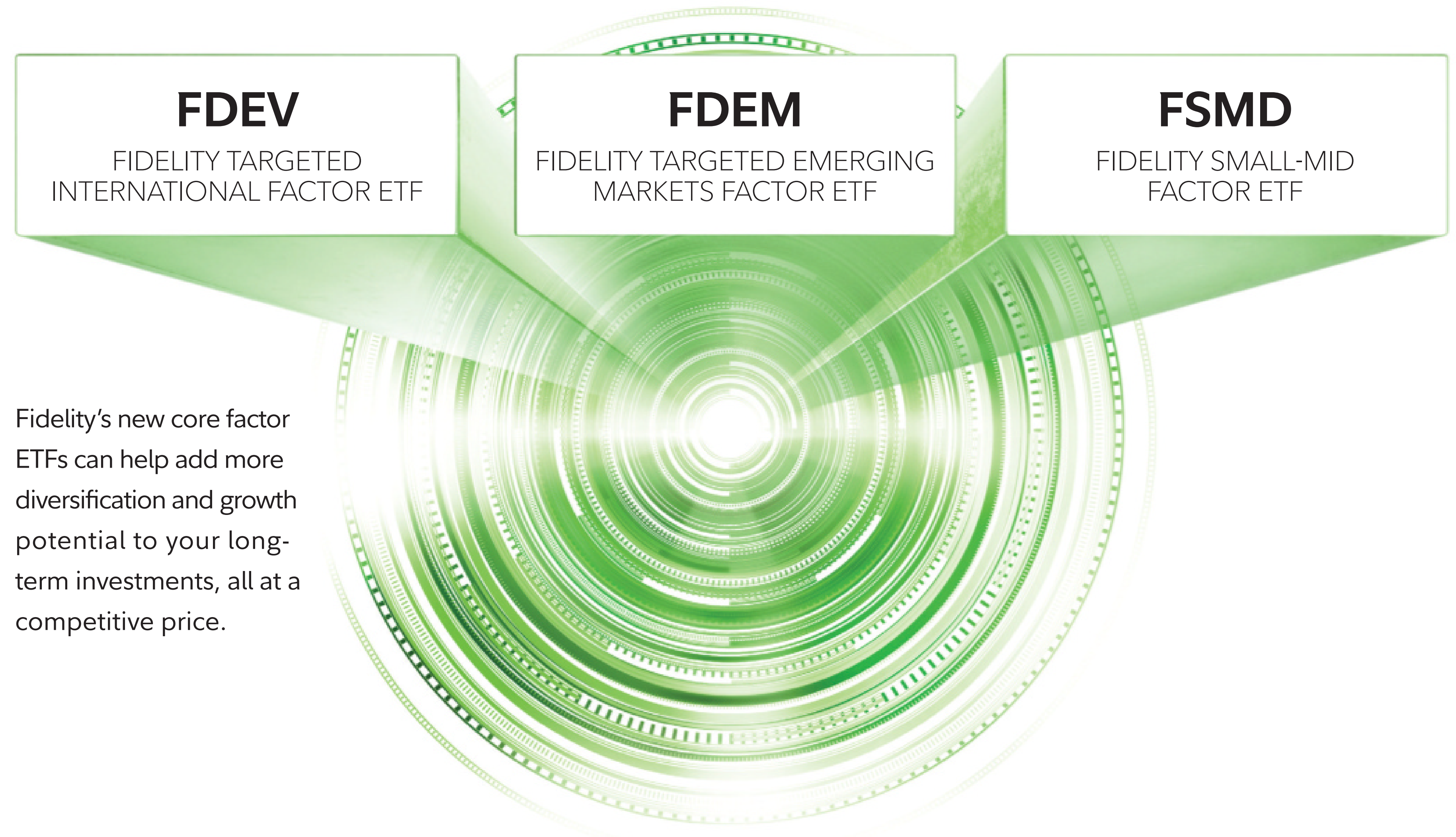

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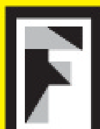

APRIL 1, 2019

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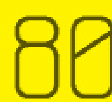

An A.I.-built map tracks the progression of CMT, a neurodegenerative disease.

GRAPHIC: COURTESY OF PHARNEXT

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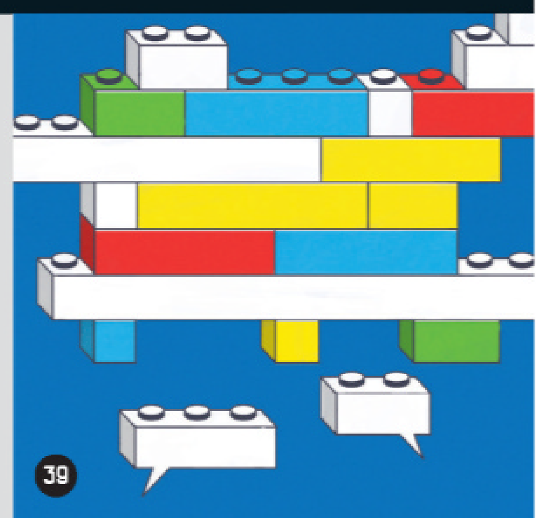

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There are more than 2 million federal employees. You may be surprised by where they work. Text by CLIFTON LEAF; graphic by NICOLAS RAPP

CORRECTIONS

"Google's Hopes and Dreams in India" [Mar. 1] incorrectly stated that Google Pay has 40 million active users globally. This figure represents usage in India only.

Because of an error in source material, "The Real Tide Pod Challenge" [Mar. 1] incorrectly stated the share of total laundry pod exposures in 2017 that involved health care facility treatment; it was 33%, not 39%. Also, a reference to a sharp increase in emergency-room visits related to laundry detergent after laundry pods first hit the U.S. market should have specified that the increase occurred among children under 6.

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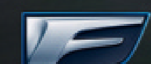

Options shown. 1. Ratings achieved using the required premium unleaded gasoline with an octane rating of 91 or higher. If premium fuel is not used, performance will decrease. 2. 2020 RC F vs. 2018/2019 competitors. Information from manufacturers' websites as of 12/4/2018. 3. High-friction brakes may require additional maintenance, be louder and have a shorter life than conventional brakes, depending on driving conditions. See the *Warranty and Services Guide* for more information. 4. AMCI Testing Certified. ©2019 Lexus

BROKEN RECORDS

AT THE SIMPLEST LEVEL, DIGITIZATION MEANS changing something, particularly information, into digital form. But that elemental description well underplays the size, the force, the impact of this process. Across the landscape of business, digitization has been nothing short of a seismic wave, shaking the foundations of venerable industries that had stood imperturbable for decades. It has uprooted business models, seeded instant commercial giants and demolished others, erased some jobs and transformed others overnight.

For consumers, however, the digital wave has brought mostly good things, it seems: more convenience, more flexibility, more options. Indeed, it's hard to think of any technological change that has delivered more power to consumers than this—thanks in large part to the digital devices we carry in our pockets or handbags. Sure, we may all be addicted to our smartphones now, but who can argue with the prospect of ordering dinner, or a car ride, or a plane ticket at the speed of a few clicks?

It was such thinking that drove the federal government a decade ago, at the dawning of the age of the iPhone, to push for a digital transformation of health care. Again, who could argue with the prospect of turning the unreadable scrawl of a physician's hand into an electronic record? Who could be against the notion of migrating miles and miles of paper medical charts to an interactive database that could be accessible anywhere, anytime?

In theory, the nationwide push to electronic health records, or EHRs, would not only reduce errors (seemingly rampant in the paper-chart era) but also fuel medical discovery, as the "big data" within was scoured for new disease patterns and even clues to potential cures. That's what thought leaders across the health care field thought. That's what politicians across the political spectrum contended.

And that's what makes the investigation by *Fortune*'s Erika Fry and Fred Schulte of Kaiser Health News in this issue (please see "Death by a Thousand Clicks" on page 56) so surprising—and so compelling. Despite a $36 billion federal investment (or maybe, as some argue, because of it), our massive effort to digitize America's medical records has been an equally massive disappointment. Instead of an efficient, interconnected, widely accessible, consumer-friendly system, we have a barely functioning patchwork of networks that often don't talk with one another—and that sometimes even jeopardize patient health, as Erika and Fred show.

The reporting behind their three-month investigation is simply extraordinary—and that's why we've devoted 16 pages of this issue to the story. You'll also find much more of this important saga—including videos, stories from patients, and other reporting—online at both Fortune.com and KHN.org.

We'll dive in even deeper to this and other issues of digital transformation at our fourth annual ***Fortune* Brainstorm Health conference on April 2–3.** Please check out the incredible lineup of speakers and topics at Fortune.com. (Click on our conference link to connect with all of our events, future and past.)

As those who get an opportunity to participate in our conferences understand—and longtime readers of the magazine and our many daily newsletters know as well—*Fortune* spends a lot of time focused on the sweeping force of digitization. We write on aspects good and bad, challenging and invigorating. We report on the disruptive, the addictive, and the informative.

But amidst all of this coverage, I have to say that Erika and Fred's epic tale of unintended consequences has truly opened my eyes. I hope it will do the same for you.

As always, please email us at letters@fortune.com and let us know what you think.

CLIFTON LEAF
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Eradicating a $600 Billion Industry

Nearly every Democrat running for President supports a version of universal health care. That has the private insurance industry on edge.

By Sy Mukherjee

HEALTH CARE

THE 2020 ELECTION is coming. And health insurers are worried.

A groundswell of support for Medicare for All among prominent Democratic presidential contenders has spooked the industry, with some candidates professing the private health insurance sector may (and even should) eventually be tossed into the dustbin of history.

Sen. Bernie Sanders—author of a comprehensive Medicare for All bill—has never shied away from a fight with large corporations, and universal health care has long been one of his hobbyhorses. But candidates occupying a more centrist space in the Democratic Party, such as Sens. Kamala Harris, Kirsten Gillibrand, and Cory Booker, have

PHOTO ILLUSTRATION BY NICOLAS ORTEGA

all cosponsored Sanders's legislation.

The bulk of the Sanders bill would be paid for by a 7.5% payroll tax on employers and 4% from workers' paychecks. The current system of Medicare and Medicaid would be scrapped and replaced with a significantly more generous program. Everyone in the United States would be covered, no opt in or out.

The big catch: You'd lose your current employer plan. "The Medicare for All bills proposed by Sanders ... would effectively eliminate the role of private health insurance providers," Larry Levitt, senior vice president for health reform at the nonpartisan Kaiser Family Foundation, told *Fortune* in an interview. "The idea of eliminating an industry and companies that are this large is unprecedented."

Under the plan, private insurers would be banned from competing with government coverage, relegating them to the role of selling supplemental insurance—table scraps compared with the $600 billion feast that private insurance is today.

Democratic politicians are finding themselves increasingly comfortable with that situation. Harris told CNN's Jake Tapper, "Let's eliminate all of that," referring to the insurance industry (she later softened her stance). Gillibrand has called it an "urgent goal."

THEY'RE ALL FOR MEDICARE FOR ALL

KIRSTEN GILLIBRAND

BERNIE SANDERS

KAMALA HARRIS

Wall Street is taking that possibility seriously. The S&P 500 Managed Health Care Index, comprising many health insurance stocks, fell 10% between Feb. 26, when House Democrats introduced their own Medicare for All legislation, and March 7. By comparison, the index was up nearly 15% in the 12 months preceding the bill's introduction.

It's hard to overstate the magnitude of such an overhaul. UnitedHealth was ranked fifth on the 2018 *Fortune* 500 list, grossing more than $226 billion last year; Anthem and Aetna (pre-merger with CVS) were both in the top 50. Those three companies alone employed more than 364,000 people in 2017.

The prospect of all of that simply vanishing has the industry preparing for a fight. Last year the nation's largest hospital, pharmaceutical, insurance, and doctors' lobbying groups formed the Partnership for America's Health Care Future (PAHCF), an organization dedicated to market-based health care reforms—and pushing back on the specter of Medicare for All.

"We want to build upon the system that's working and fix what's wrong," Lauren Crawford Shaver, PAHCF's executive director, told *Fortune* in an interview. "In many of these Medicare for All proposals, it's very unclear what they actually want to do. They're looking to start all over. Why not pause for a second and improve what we have?" Shaver points to polls showing that Americans' support of Medicare for All, which is 71% if told it would guarantee health care as a right, falls to 37% when told it would eliminate private health insurance.

But insurers for the most part haven't offered up a whole lot of suggestions for fixing the current private system and feel little need to, according to KFF's Levitt. "Right now, I'd expect health insurers to just trash the idea of Medicare for All without offering an alternative," he said.

That could be a miscalculation. The cost of private insurance has been rising consistently, and employers have increasingly shifted costs onto their workers—while wages have largely not kept pace.

Those financial realities and the frustrating, jigsaw nature of U.S. health care are fueling the enthusiasm for Medicare for All.

The Sanders bill has a zero probability of passing before 2021. But in a scenario where Democrats win the White House and total control of Congress in 2020 (and nix the Senate filibuster), it's not in the realm of fantasy that some form of Medicare for All could pass.

Falling short, Democratic leaders would still be likely to push for expanded access to Medicare (by lowering the enrollment age to 55, for example).

If insurers can't offer a compelling alternative to calm the swell, they could soon find themselves fighting against an industry-drowning tide.

Read daily analysis of the health care industry in the Brainstorm Health *newsletter at* fortune.com/digitalhealth

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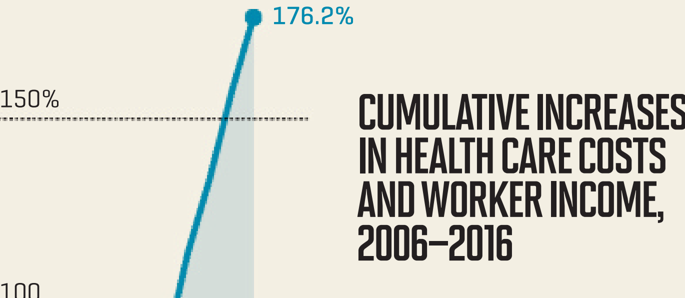
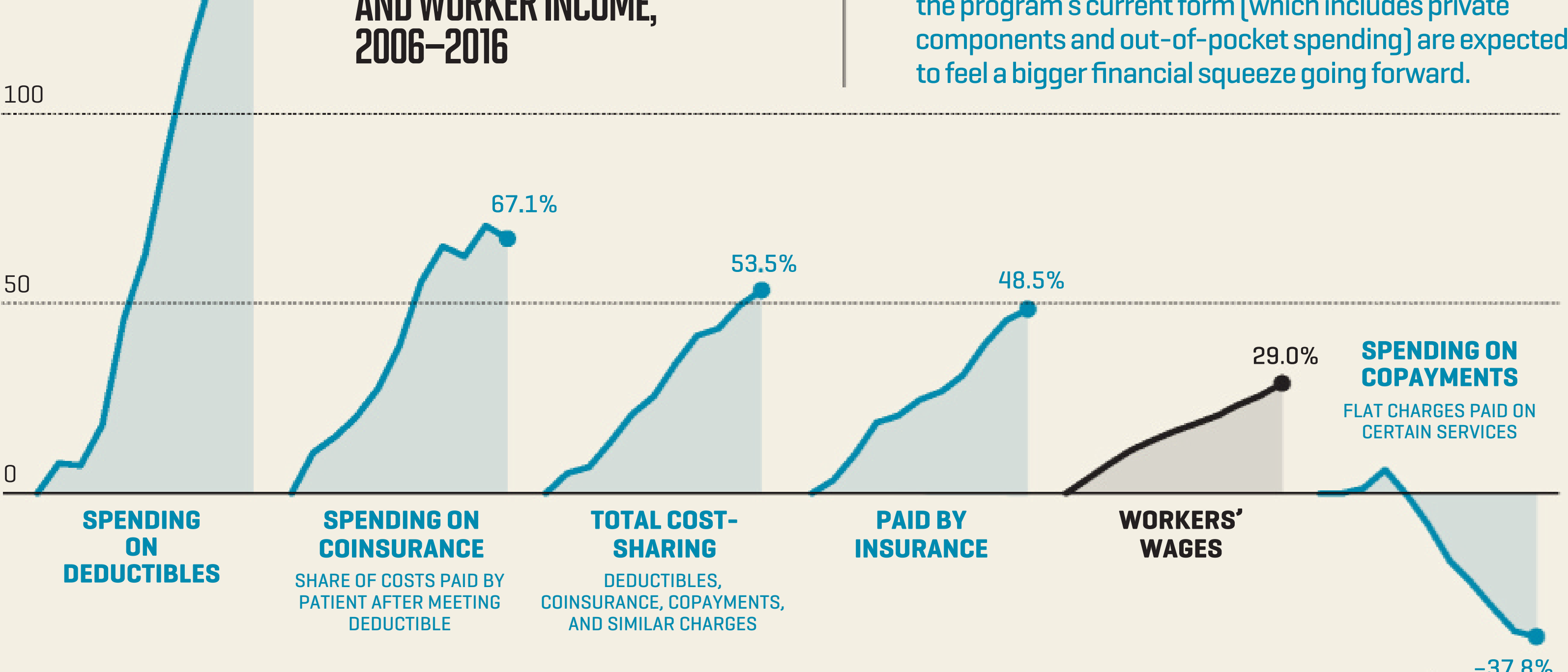
ANALYTICS Seeing Trends in the Data

WORKERS, SENIORS FEEL THE HEALTH CARE CRUNCH

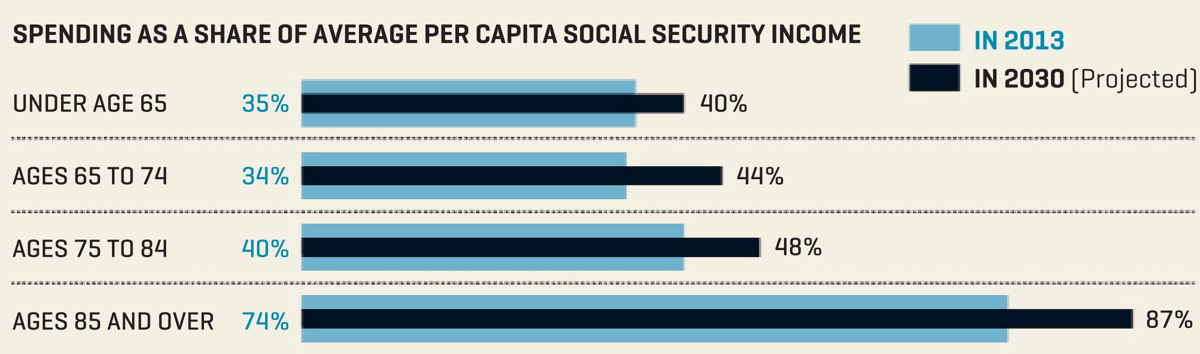
For many workers, health insurance is no longer what it once was. Health care costs borne by employees in the form of deductibles and coinsurance rose at a far faster rate than what employer-sponsored insurers paid for care between 2006 and 2016, according to the Kaiser Family Foundation. Even Medicare beneficiaries under the program's current form (which includes private components and out-of-pocket spending) are expected to feel a bigger financial squeeze going forward.





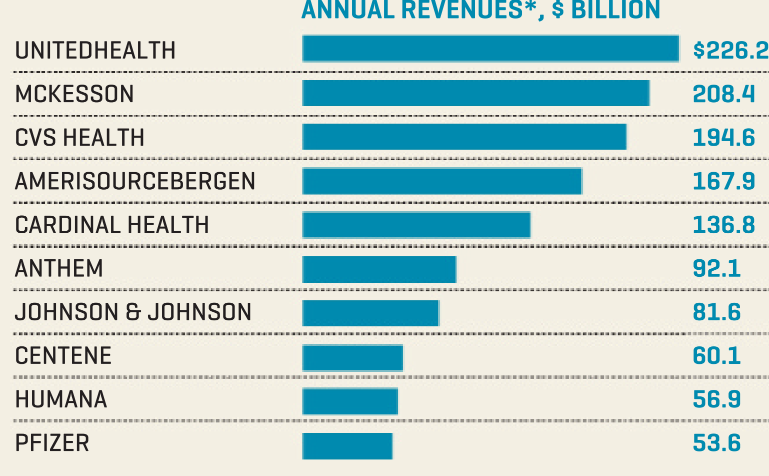
INCREASE IN OUT-OF-POCKET SPENDING FOR MEDICARE BENEFICIARIES

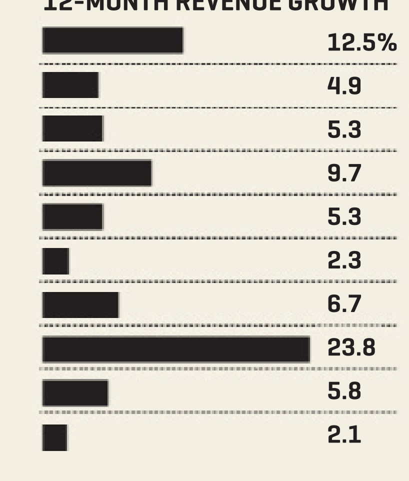
Under the current Medicare system, beneficiaries are on the hook for supplemental private insurance and out-of-pocket spending for certain services—and this spending is expected to increase significantly relative to what seniors receive from Social Security by 2030.



HEALTH CARE COMPANIES ARE IN A HEALTHY POSITION

Health care isn't just big business—it's massive business. Insurance giant UnitedHealth, drug distributor McKesson, and CVS Health (even prior to its acquisition of insurer Aetna) took the fifth, sixth, and seventh spots in the 2018 *Fortune* 500; other insurers including Aetna and Anthem landed in the top 50.





* LATEST FISCAL YEAR

SOURCES: KAISER FAMILY FOUNDATION; BUREAU OF LABOR STATISTICS; S&P GLOBAL

GRAPHICS BY **NICOLAS RAPP**

PAGE 4

Kraft Heinz: A Cautionary Tale

Cost cutting didn't help Jell-O and wieners in an avocado-toast world. By Shawn Tully

MERGERS

THE SHARES AND REPUTATION of Kraft Heinz took a huge hit when the world's fifth-largest food company announced a $15.4 billion write-down on Feb. 21. It broadcast the failure of a brutal cost-cutting campaign, pioneered by one of its biggest shareholders, Brazilian investor 3G Capital. Wall Street had initially praised 3G's moves, but what was advertised as the cure has now cost the ketchup-maker a lot of blood.

Here are the three ways a maniacal focus on costs savaged a storied name.

REVENUES WENT NOWHERE

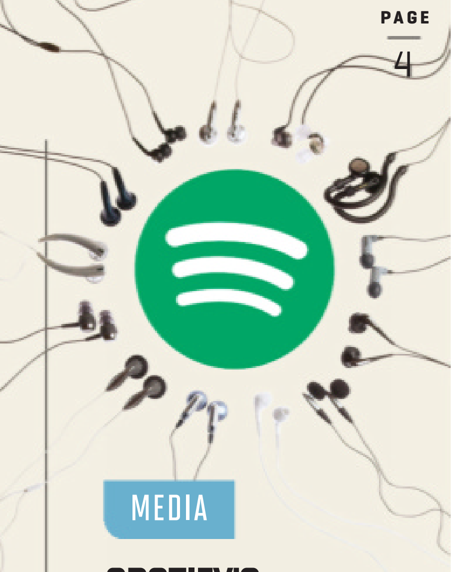
• From the close of 2016 to the end of last year, Kraft Heinz revenues fell by almost $229 million, or 1%, to just over $26 billion. The company skimped on the marketing dollars needed to support its brands and further antagonized retailers by resisting their demands to discount the likes of Kraft cheese slices.

FALLING MARGINS

• From 2015 through 2018, Kraft Heinz lowered its adjusted non-production-related costs from 10% to 8% of sales, the payoff from its once-vaunted cost management effort. But gross margins dropped even more, by 3.5 percentage points—overwhelming the progress on overhead. Despite efforts to preserve pricing, Kraft Heinz suffered shrinkage in margins, as private-label brands from Costco and Kroger squeezed its profits on such signature products as Oscar Mayer hot dogs. In a TV interview following February's bombshell, Warren Buffett, whose Berkshire Hathaway owns 27% of Kraft Heinz, acknowledged "a weaker bargaining hand" that rendered Kraft Heinz "not as strong as we thought."

A FAILED STRATEGY

• By the middle of 2016, when Wall Street was touting the genius of 3G, Kraft Heinz's stock was trading at a premium to book value of $50 billion. Today its valuation is $28 billion below the equity dollars invested by its owners, including the $15.4 billion write-down. In effect, investors are predicting that Kraft Heinz will earn about one-third less in the years ahead than the company forecast a few months ago. Reviving aging brands like Kool-Aid or Kraft Mac & Cheese in a world where millennials demand healthy choices will be one of business's toughest challenges.



MEDIA

SPOTIFY'S PODCAST PLAY

SPOTIFY'S $340 million purchase of two podcasting companies, Gimlet Media and Anchor, is not just an attempt to dominate every facet of your audio experience. It's also about making the company profitable (finally).

Music, the main reason users shell out $9.99 a month for a premium Spotify account, is largely controlled by record labels. That means royalties must be paid every time you play Lady Gaga or Cardi B, an impediment to Spotify's becoming a profitable company despite its 200 million global users.

Becoming its own record label isn't a workable solution, as Spotify would risk losing the music catalogs of huge artists on other labels.

But if a user listens to a Spotify-produced podcast, the benefits are twofold: less money paid to licensing, and an opportunity for advertising revenue.

Simply put, Spotify wants you to listen to less music.

—ARIC JENKINS

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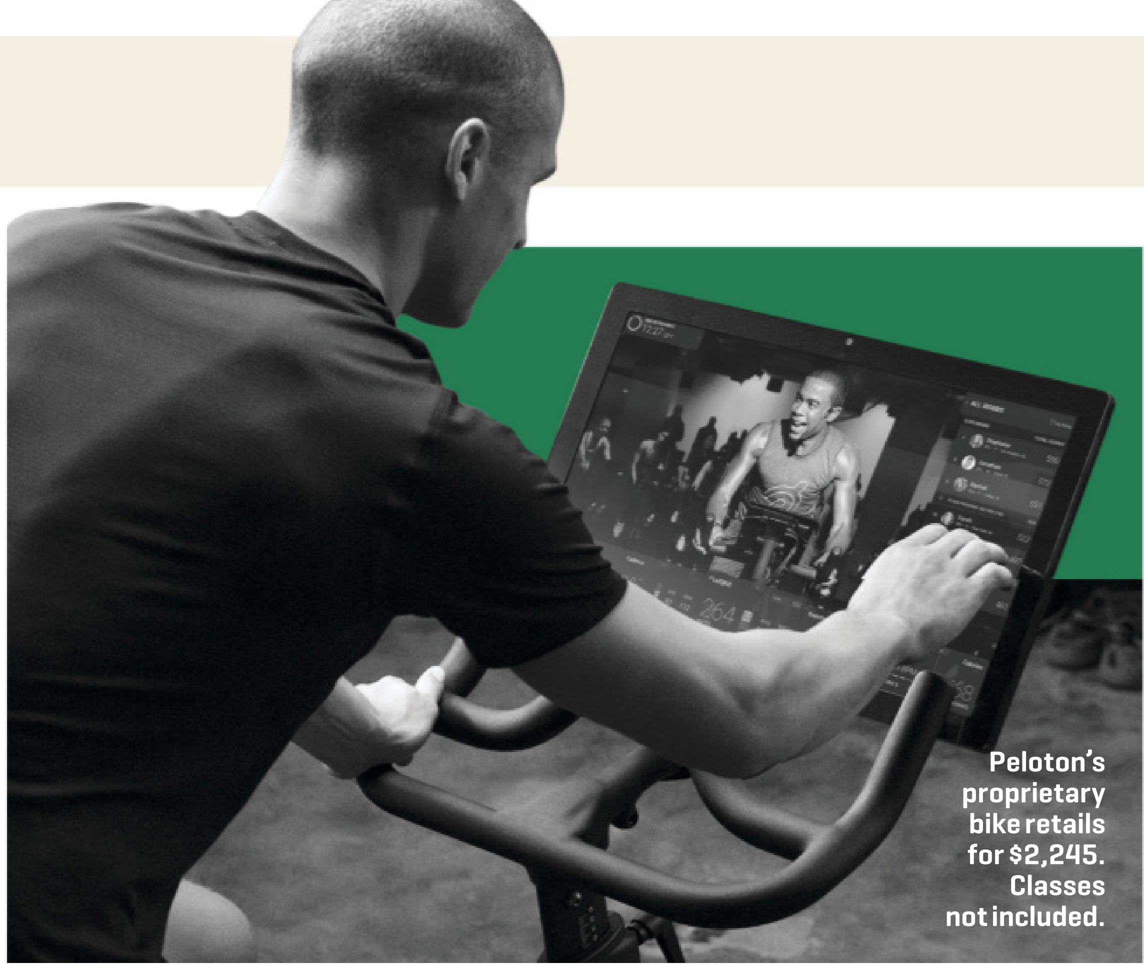


Peloton's proprietary bike retails for $2,245. Classes not included.

Peloton's Climb

The leader in bringing studio workout classes to the masses is going public. By Daniel Bentley

UNICORNS

BY NOW YOU'VE seen the ads. A trim young professional is riding an exercise bike in a perfectly appointed high-rise apartment, his face lit by the glow of a tablet in front of him. You can't hear the instructor on the screen, but you can imagine the sort of motivational spiel being called out to the riders.

This is Peloton, and it's the biggest thing in home exercise since Jane Fonda in leggings. The company, founded in 2012, sells its proprietary bike for $2,245 and a monthly subscription to video streams of its live and on-demand classes for $39. Last year it introduced a $4,295 treadmill and expanded its class offerings.

A marketing blitz has pushed Peloton's user base past that of rival SoulCycle. According to credit card transactions analyzed by Second Measure, Peloton eclipsed SoulCycle in 2018. Peloton hasn't released user numbers but says it doubled its subscribers last year.

Now Peloton is preparing to do what SoulCycle backed out of doing in 2018: go public. When it files, analysts will be keen to learn the margins on both its high-priced equipment and subscriptions. It's that combination that has been irresistible to investors. The company has raised just short of $1 billion in private money, with a valuation as of its last round of $4 billion.

With further growth, user retention will be key. Peloton instructors, social media celebrities in their own right, do an impressive job at keeping home riders engaged. But as classes balloon in size, they risk losing that personal touch.

If it can keep that boutique-class feel, even as 10,000 people ride along concurrently, Peloton will continue to lead the pack.

YOUR NEXT COCKTAIL WILL BE PREMIXED

BOOZE

SOMETIMES WE ALL FEEL THE NEED for speed—more often than not at happy hour. That's why bartenders are increasingly turning to premade and bottled cocktails to cut down on wait times and boost sales. New York City's Dante, known for its signature negronis, has been pre-batching drinks since the bar was revamped in 2015. And customers don't seem to mind—or even notice—that their cocktails aren't always made to order. "I don't think customers care either way," says the bar's creative director, Naren Young. "What they want is to get a drink in their hands quickly, which puts everyone at ease and sets up the right pace for their experience." —**RACHEL KING**

COCKTAIL: MARTIAPUNTS—GETTY IMAGES; PELOTON: COURTESY OF PELOTON

Hey Nike, Support Student Athletes

A former college football player says the company can make a difference. By David Grenardo

COMMENTARY

THE INJURY SUSTAINED by Duke University basketball star Zion Williamson—after his Nike shoe ripped apart on the court—renewed the debate over whether elite student athletes should risk their bodies playing in college when they stand to make substantial pay as soon as they go pro.

Ire has been directed at the professional leagues, the NCAA, and universities that support this unfair system. Yet, left mostly unscathed in these discussions are apparel brands like Nike, which reap the rewards of sponsoring college athletics while remaining silent on one of its most important issues.

It's time for that to change. Nike and other companies should work together to end university athlete exploitation by suspending their support of college teams until players are paid.

College players provide free labor for the $11-billion-a-year industry of college football and men's college basketball, but NCAA rules prohibit them from receiving compensation on top of their scholarships or signing endorsement deals. If these amateur players hope to ever be paid, they must participate in this system, since professional leagues like the NBA allow players to join only once they turn 19, and the NFL maintains a three-year waiting period after high school before a player can enter the league.

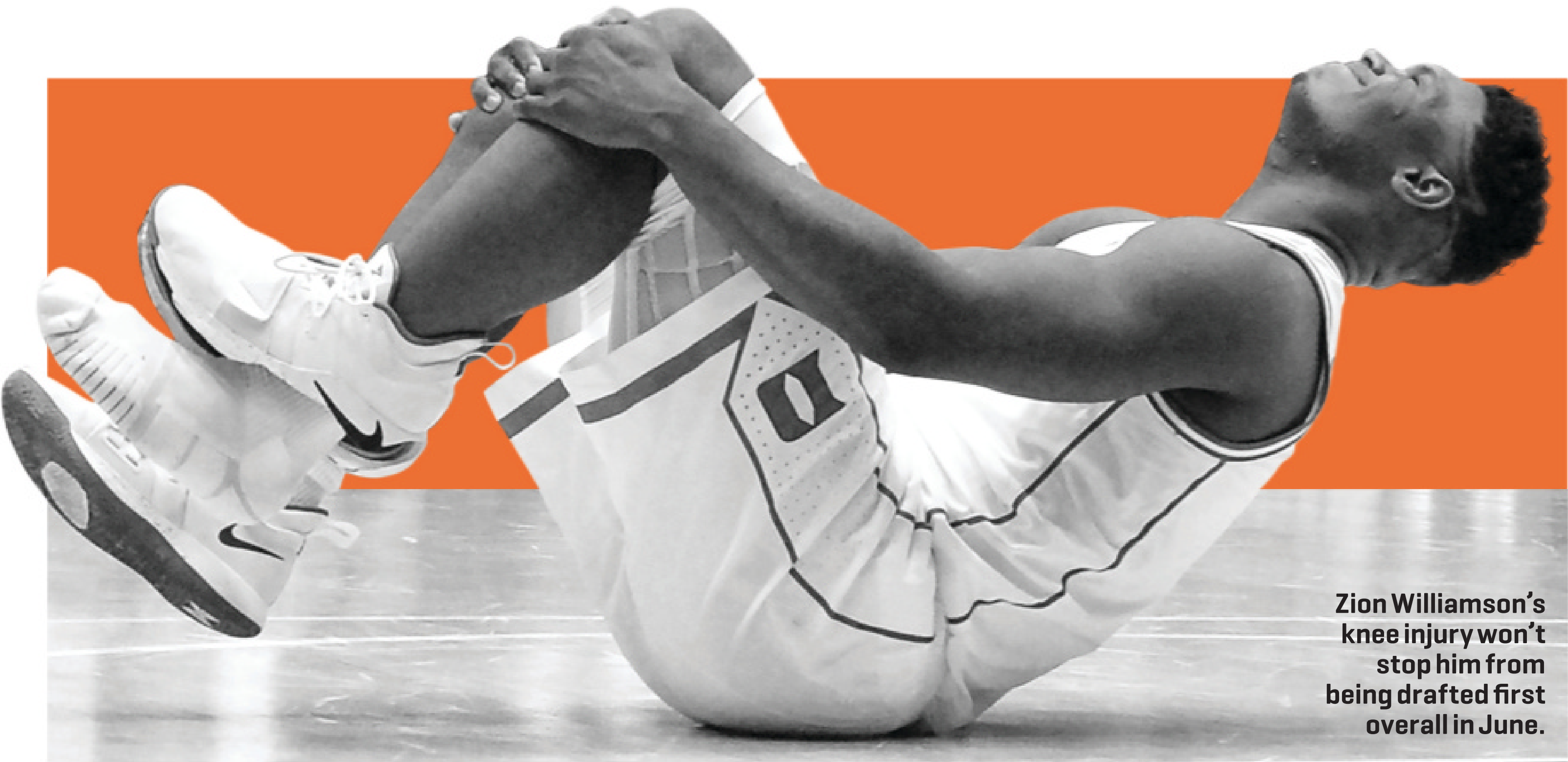
At the same time, the major apparel brands, the NCAA, and its member schools profit greatly. In 2016, Under Armour negotiated a $280 million deal with UCLA for 15 years. Nike signed a similarly lucrative $252 million agreement with Ohio State University in 2016.

For Nike, its Colin Kaepernick ad campaign has positioned the company in line with progressive values. Failing to support student athletes in obtaining fair compensation would contradict that message.

Supporting young athletes can be good business, particularly if rules are changed to let college stars endorse products.

Apparel companies have moral, financial, and reputational incentives to agitate for a change to NCAA compensation rules. With that in mind, it's time for brands like Nike to just do it—support college athletes being paid.

David Grenardo, a four-year football letterman at Rice University and a Duke Law School alumnus, is a St. Mary's University School of Law professor in San Antonio.



Zion Williamson's knee injury won't stop him from being drafted first overall in June.

© WILLIAMSON: CHUCK LIDDY—RALEIGH NEWS & OBSERVER/TNS VIA GETTY IMAGES

TRADE

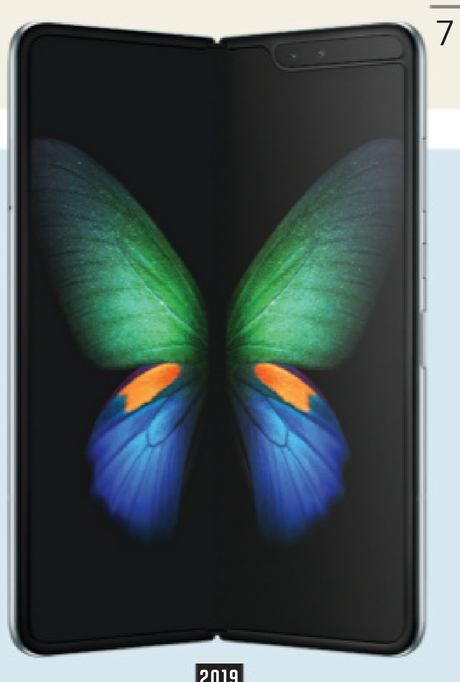
WHEN CHINA SPEAKS, THE MARKETS LISTEN

IN MID-FEBRUARY, President Trump announced that negotiations in the Middle Kingdom to resolve the trade war with China had gone "very well." But some wary traders couldn't take the Commander-in-Chief at his word. Instead, they waited until the Chinese government's mouthpiece, Xinhua News Agency, confirmed the news to give the S&P 500 a nice 30-point bump.

The reason: Investors simply don't know whom to believe with mixed messages coming out of the White House. Trump's optimism was tempered by U.S. Trade Representative Robert Lighthizer, only to be reinforced by National Economic Council director Larry Kudlow. With the morass of competing insights, Chinese state media, of all things, is now a more reliable narrator. —LUCINDA SHEN

1983
MOTOROLA DYNATAC 8000X
$3,995
equivalent to $10,000 today

2000
NOKIA 3310
$169
equivalent to $260 today



2019
SAMSUNG GALAXY FOLD
$2,000

Foldable Phones Are Coming

Whether we want them or not. By Aaron Pressman

GADGETS **DEVICES FROM A TRIO** of handset makers had the halls buzzing at the recent Mobile World Congress in Barcelona. Samsung, Huawei, and TCL all showed off their take on phones that unfold into larger-screen tablets. Samsung's Galaxy Fold has a typical phone screen on the outside and opens like a book with a separate 7.3-inch screen on the inside. But it's priced at almost $2,000 and appears to be quite a bit heavier and thicker than most current phones. Huawei's seemingly thinner and more desirable device—called the Mate X—will start at $2,600.

In a market in which the top-spec iPhone sells for just shy of $1,500, will customers pony up? CCS Insight analyst Ben Wood says these foldable phones remind him of the brick-like Motorola DynaTAC 8000x, toted by Gordon Gekko in *Wall Street*. It weighed almost 2 pounds and cost $4,000—or over $10,000 in today's dollars—when it debuted in 1983.

"People have short memories," Wood says. "This is cutting-edge technology, and that always comes with a premium price. There is little doubt prices will decline over time."

Expect the status conscious to spend big now but buy better versions—for less—down the line.

YOUR MONEY

FEWER REFUNDS TAX RETAILERS

IT'S REFUND SEASON, BUT THIS YEAR Uncle Sam has been doling out less money than usual. Because of withholding changes stemming from President Trump's 2017 tax bill, the average refund amount has risen by $22 to $3,068. But 2 million fewer refunds have been issued compared with last year, according to the first five weeks of data available from the IRS. That's bad news for retailers of big-ticket items like furniture, electronics, cars, or home appliances, who have come to expect a glut of disposable consumer income during tax season. —ROBERT HACKETT

MOTOROLA: TIM BOYLE—BLOOMBERG VIA GETTY IMAGES; NOKIA: SSPL/GETTY IMAGES; SAMSUNG: COURTESY OF SAMSUNG; XI AND TRUMP: FRED DUFOUR—AFP/GETTY IMAGES

ROCKY START Sneader became McKinsey's chief in July, inheriting multiple ethical crises.

Q+A

KEVIN SNEADER

Recent revelations have subjected consulting giant McKinsey to awkward scrutiny. Its leader describes what could change at the influential and secretive firm.

Interview by Adam Lashinsky

KEVIN SNEADER, A 52-YEAR-OLD Glaswegian and 30-year veteran of McKinsey & Co., became the firm's global managing partner in July. He spoke by phone on March 6 with *Fortune* about the firm's very public spate of controversies, from charges of conflicts of interest in its bankruptcy advisory business to embarrassing entanglements from Saudi Arabia to South Africa and beyond. The conversation has been edited for clarity and space; you can read the full transcript at fortune.com.

***FORTUNE:* You live in Hong Kong, have visited San Francisco and New York recently, and are in Europe today. How many airline miles did you log last year?**

KEVIN SNEADER: I prefer my wife not find that out. British Airways had this wonderful idea at the end of the year, which is to send an email that shows all the places you've been and the number of times you've been around the world. I stayed away from it.

We'll mark you down as evasive for a legitimate reason on that one. Let's discuss McKinsey's public issues, starting on the topic of transparency. What were McKinsey's 2018 revenues and profits?

Our revenue is running about 10 billion U.S. dollars.

And profitability?

As a private partnership, it's not one of the things we talk about.

How about the top five revenue-producing clients?

One of the things that we've always shied away from is talking about the clients in the sense of revenues because it's not the way we think about them. And it's not the way I think our clients think about us. Because what they're focused on is what we do for them. I'm very happy to talk about the kind of work we do and the way in which we do that work. But I think actually to disclose who our largest clients are, that's something we've not yet got our heads around today.

I think that cuts to the heart of the matter. You are publicly professing a desire to be transparent, but the very nature of McKinsey works against transparency.

Well, first of all, I told you our revenue number. That's one number that we certainly spent no time on in the past. Secondly, I think we can be more transparent about ourselves

STUART ISETT—FORTUNE BRAINSTORM REINVENT

because we have been mysterious. I'll give you an anecdote to bring that home and how far I think we are willing to go versus where we've been. When I joined the firm, in London, I remember booking a taxi to the client location. I was very quickly told you don't do that. You book the taxi to two blocks away, or as we say in the U.K., "round the corner." We've always thought about guarding client confidences, maintaining their secrets. But I think where the line can get drawn is being very clear that that doesn't mean we can't be much more open about who we are.

I have the unique perspective of having been a McKinsey client when you advised Time Inc., the former owner of *Fortune*. [Note: McKinsey is also a sponsor of several *Fortune* conferences.] So I know about two McKinsey product lines: growth strategy and cost cutting. What is the revenue mix between those two?
Well, we slice and dice in 90 [other] ways than you've just described. And actually I don't know the answer, and I'm not trying to play games here. It's just not the way we would look at it because we look at it against the different types of work we do, whether it's strategy, marketing, organization, and so on. Strategy is about a third of what we do. Organization is probably about half that number. Cost work for many years was a big part of the firm's activity. But there's really been a shift toward helping our clients with growth.

McKinsey recently agreed to pay a $15 million fine in which the U.S. Trustee Program of the Department of Justice said the firm "lacked candor" in the way that it communicated with clients in its bankruptcy practice, and that it made "insufficient disclosure" about its investments. You have said that McKinsey relied on advice for its disclosures practices. Whose advice?
I want to try and make sure I restate that just to be clear. We've always relied on and been responsive to guidance from the U.S. Trustee and the bankruptcy courts. That's essentially what I was saying, and we will continue to respond to whatever guidance they provide us. We agreed to that settlement so that we could put that issue behind us.

Would you agree that the government is essentially saying McKinsey did not use good judgment, which is the backbone of its reputation?
As I said, one of the main reasons for that settlement is that we respect their views. And we are keen that we move on. So I'm not going to second-guess the statement of the U.S. Trustee.

The *New York Times* has written extensively about your hedge fund, MIO Partners, which invests the personal assets of McKinsey's partners. It called the fund overly secretive and conflicted for investing in McKinsey clients.
We have asserted consistently that MIO is a separate subsidiary. It was established 30 years ago. I don't think it's particularly secretive. It's regulated. There's a lot of oversight of it. But it is separate from our consulting activities. There have been reports into it that have validated that view.

What reports, and will you publish them?
We don't need to because one of them is a report that was commissioned by the Puerto Rico Oversight Board. It's called the Luskin Report. It's a completely independent review commissioned for that entity, not by us. And it had choice words about the independence of the entity called MIO.

The *Times* reported that McKinsey partners or ex-partners make up the majority of the hedge fund's board of directors. Is that accurate, and won't that make it impossible to put this question behind you?
I think it's important to understand what that board does. It only reviews after the fact what has actually happened to the small part of the investments that MIO makes that are not covered by fund-of-funds-type activity. That covers 90% of the activity. Essentially, it does not have real oversight into any of the investment decisions that are actually being made.

Would McKinsey consider selling the hedge fund? After all, there's nothing stopping you from investing partners' assets in other hedge funds.
Thirty years ago those options didn't exist. The fund was founded to provide a way of ensuring, given that McKinsey partners cannot invest in individual equities, we had a mechanism to ensure that any investment activity was robust and distinct from the day-to-day consulting activities of the firm. Obviously,

GLOBAL GRAY AREAS AND MISSTEPS MADE PUBLIC

Recent lawsuits and reports have drawn attention to, and raised ethical questions about, McKinsey's work. A few examples:

SOUTH AFRICA
▸ To win a contract with state-owned utility Eskom, McKinsey partnered with a local firm that was later implicated in a sweeping corruption scandal. In July, McKinsey apologized and repaid $72 million in fees.

SAUDI ARABIA
▸ In October, the *New York Times* reported that McKinsey had produced a study identifying social media critics of the Saudi regime, one of whom was subsequently arrested. The firm says the study was an internal project, not produced for the Saudi government.

BANKRUPTCY PRACTICE
▸ In February, McKinsey paid $15 million to resolve a federal probe into conflicts of interest in its bankruptcy practice. The firm says the settlement was not an admission of wrongdoing.

we should look at anything that helps in that regard, but as you can appreciate, there are lots of options we could consider. That could be one of them.

You've taken heat for client work you've done in South Africa, in Saudi Arabia, with arms of the U.S. government. What are McKinsey's criteria for choosing clients?
There are several criteria. And one of the things that they include is obviously being clear on whether we use this space to make a positive, lasting, and substantial difference. When we look at the criticism, which dates back over decades, we've made mistakes in some places. And one of the things is to broaden that definition of how we think about the role we play with a client and, frankly, be more aware of the environment and the context in which we're serving clients.

So what constitutes a no-go zone for a McKinsey engagement?
First and foremost, when we think about serving clients, we are very keen to understand their integrity, who they are individually and institutionally. If I look at some of the mistakes we made in South Africa, to be fair, perhaps one of the biggest mistakes was allowing ourselves to be associated, in this case, not with our client so much but with a third party that we never engaged with, but was engaged by the client.

If you take the Saudi Arabian situation [in which McKinsey consultants wrote a report on reaction to government policies that identified regime critics], the document that was produced, that was a mistake. To be clear, it was not produced for a government entity. But it did talk about, and it used, analytical techniques to talk about the way in which individuals had reacted to that government's austerity measures that should not have happened. And the actions we're taking are designed to ensure that does not happen again.

It was an internal McKinsey document that was produced to showcase how you can apply analytic techniques to social media. And of course, by using public data, it was highlighting people who between them had something like—I think it was—800,000 tweets. I might get that number wrong but a huge number of public utterances in the form of tweets. This was not identifying people who were lying low. I'm not excusing it. It should not have happened. But it was not for the government.

"WE'VE ALWAYS THOUGHT ABOUT GUARDING CLIENT CONFIDENCES. BUT THAT DOESN'T MEAN WE CAN'T BE MUCH MORE OPEN ABOUT WHO WE ARE."

Have you undertaken a top-to-bottom review of every existing client engagement to determine if each one meets your new standards?
That is one of the things we are finalizing. We're working right now to put together a new set of ways in which we evaluate clients. And not just clients because it could also be the individual topic on which you're working. We are intent on applying that to our full client portfolio.

Do you anticipate, and would you be comfortable with, that resulting in a short-term decrease in firm revenues?
Yes. Of course. Our intent is to make sure we feel comfortable and confident about the work we're doing. And selecting the right clients is a key part of that work. And if the consequence of that is in the near term we have to make some real changes, then we're prepared to do that, yes.

McKinsey itself is unregulated and not subject to the kind of scrutiny and oversight your clients are. Do you see a scenario where that changes?
First of all, we feel a lot of scrutiny, and that scrutiny first and foremost is from our clients. But it also comes from the outside world in many different forms, whether it's media or the fact we do operate in areas that are regulated, as you've already pointed out in some of the questions you asked me at the beginning.

Has McKinsey suffered a hit to its reputation?
Our reputation is made every day when 5½ thousand McKinsey teams go to serve their clients. One of the things I've been very struck by in recent weeks is the response of our clients, who are standing by us and standing with us. We've also had one of our best recruiting seasons, and it's been right in the midst of all this media publicity. So have we taken a hit? Of course. But I know what we'll do is show that we hear, we're listening, we're acting, and we'll come back stronger because we'll redefine and raise the bar on what it means to be a professional at a time of great change, not just for us but for business as a whole. F

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CENTENE CORPORATION HAS LONG FOCUSED ON DELIVERING BETTER healthcare at lower costs. Centene is the largest Medicaid managed care organization in the U.S., a national leader in managed long-term services and supports, and the largest insurer on the Health Insurance Marketplace. Ranked among *Fortune*'s Most Admired Companies, the St. Louis–based organization maintains contracts in 32 states and an international presence.

By leveraging cutting-edge technology to better serve its members, Centene harnesses the latest tools to help improve health outcomes. Developing complex algorithms through machine learning to better predict human behavior means that the company can proactively deliver specialized programs and targeted interventions to individuals most in need.

Centene leverages the power of **Interpreta**, an analytics engine with a robust database that can reveal which segments of the population are more susceptible to important health concerns. By analyzing 12 million medical data points in less than a minute, **Interpreta** can identify physiological changes that could signal opportunities for additional care.

On the prescription drug side of member care, Centene's investment and partnership with **RxAdvance** helps doctors identify potential lower-cost options within therapeutic categories, highlighting how prescribing decisions affect treatment costs.

Centene has introduced the pharmacy benefit manager's (PBM) cloud-based platform, beginning with its health plan in Mississippi, Magnolia Health. All plans are expected to use the platform by the end of 2020.

"We've made this important technology investment to support a shift toward a more transparent pharmacy benefit management model, one that is sustainable with higher quality and lower costs for consumers," says Michael Neidorff, chairman and chief executive officer of Centene. "**RxAdvance**'s transparency, disruptive technology, and unique approach to partnership will help us further improve quality health outcomes for our members and other customers, while managing healthcare costs."

By integrating pharmacy, medical, and lab data, the customizable platform enables real-time engagement by physicians, pharmacists, and consumers. **RxAdvance**'s model fosters compliance and reduces touch points in the prescription process, automating aspects of claims processing. It can also be used to optimize prescription drug spending.

Centene was ranked #1 on *Fortune*'s 100 Fastest-Growing Companies list based on revenue growth over a 10-year period. This year, it expects to generate revenues exceeding $70 billion, and Neidorff believes partnering with innovators like **RxAdvance** furthers Centene's leadership position in healthcare.

"Our continued investments in new technology have significantly enhanced our ability to scale, coordinate, and deliver care," says Neidorff. Still, "while we embrace technological progress, we never lose sight of our purpose: Transforming the health of the community, one person at a time."

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FOCUS

The company's new hi-fi mirror undergoes testing.

TECH

EXTREME MEASURES

Simplehuman, the high-end housewares maker, takes product testing very seriously. The obsession appears to be paying off.

By Sheila Marikar

PHOTOGRAPHS BY **JOE TORENO**

IN THE BACK OF A BIG WAREHOUSE in Torrance, Calif., engineers at home-essentials maker Simplehuman are putting the company's voice-activated trash can through its paces. The goal: to test the reliability of its voice-recognition technology by subjecting it to a sonic pummeling.

Every 10 seconds, hour after hour, a robotic voice from a speaker repeats, "Open can." And every 10 seconds, hour after hour, the lids on a quartet of trash cans, arranged in a square in the middle of the room, open and close. A camera records video so that engineers can analyze any hiccups.

"If we start talking really loud, I bet one of them might fail," Simplehuman CEO Frank Yang says coyly.

Simplehuman, described by some as the Apple of housewares for its sleek soap dispensers, high-tech mirrors, and dish racks, has attracted a devoted customer base. Last year its revenue grew 15% to more than $200 million, the company says.

Simplehuman's rise comes despite stiff competition in the market for kitchen and bathroom products. Rubbermaid and Hamilton Beach produce cheaper trash cans, for instance, while Conair and iHome also churn out tech-enhanced mirrors.

But Joe Derochowski, an analyst for market research firm NPD Group, says what sets Simplehuman apart is the little extra it adds to its products. Higher-end home essentials, not cheaper products, accounted for nearly all of the 5.9% growth in the $26.7 billion housewares market last year.

"They're an example of how you can take something simple like a mirror or a garbage can, innovate it, pair it with some great marketing, and do really well," says Derochowski.

Simplehuman's slogan is "Tools for efficient living," and last spring, Yang and his staff of 100 finished moving into what he calls a "tool for building innovative products." It's an open-plan office with an indoor basketball court (Yang shoots hoops when he's stressed) and labs where Simplehuman tests and tweaks products.

Around the corner from the opening and closing trash cans is a quiet booth with foam-padded walls. Yang opens the door, and Ed Sheeran's "Shape of You" comes blasting out.

Two technicians are testing the speaker attached to Simplehuman's latest product, a hi-fi mirror that debuts this April. It's optimized for applying makeup, with 5x magnification, different lighting options (cool for daytime, warm for evening), and—here's that added consumer benefit—a base equipped with a Bluetooth speaker that a Grammy-winning artist like Sheeran would probably find up to snuff.

"I'm a bit of an audiophile," says Yang. "We've gone through 21 iterations of sound profiling—after 17, it started sounding okay."

Simplehuman's staff spent more than 8,000 hours developing the mirror and its illuminated ring so that light is evenly distributed around its circumference. It brightens with the touch of a finger rather than the flick of a switch, and in another room, there's a microscope-like device that projects lines onto the mirror's surface to make sure it reflects like a mirror should: If the lines are straight, the mirror's good; if they're curved, it's not.

A second version of the mirror, on sale in May, comes with Google Assistant, the voice-activated helper that recites information on command. It's an example of Simplehuman jumping on the latest tech bandwagon, popularized by smart speakers like Amazon Echo, while keeping true to its design philosophy.

Simplehuman, led by founder and CEO Frank Yang, is sometimes called the Apple of housewares for its sleekly designed products.

Yang started Simplehuman 19 years ago with a $200,000 loan from his father, a Taiwanese immigrant who founded a company that makes storage units. "I worked with him for four years, and I got so bored,'" Yang says.

Unenthused by the idea of simply mocking up a new product and sending it to a factory in Asia to fabricate, as some of his competitors do, Yang builds his own prototypes. His company has owned 3D printers since 2013 and a circuit-board printer since 2016. Even now, he gets giddy when he walks by it.

"It's the same game as the iPhone," Yang says. "How do you put in a more powerful battery? You have to make other stuff smaller, and then the end product can be smaller, or"—he smiles—"you can make it do more things." ■

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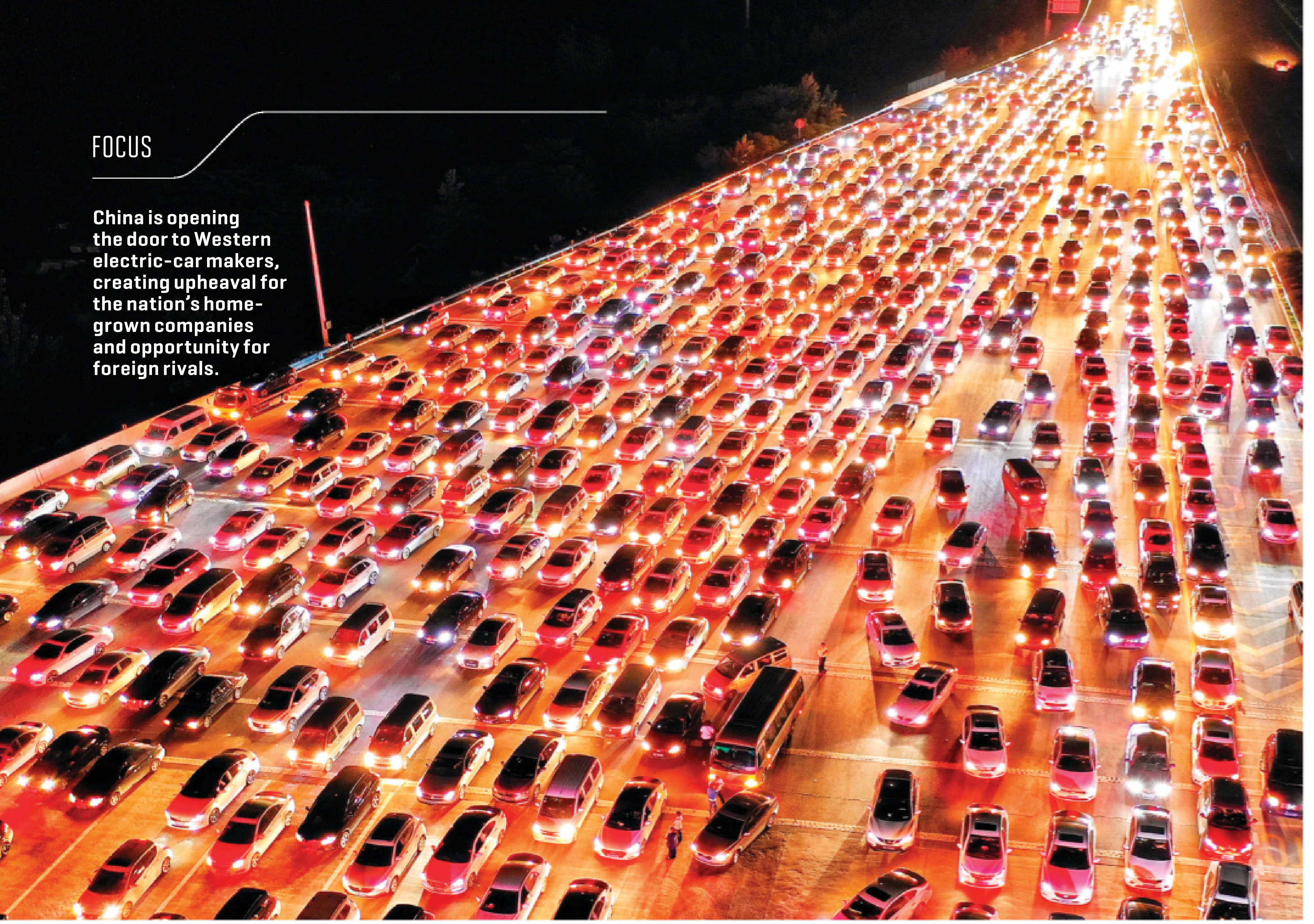
FOCUS



China is opening the door to Western electric-car makers, creating upheaval for the nation's home-grown companies and opportunity for foreign rivals.

CHINA'S ELECTRIC-CAR SHOWDOWN

Tesla, General Motors, and Volkswagen are betting big on the world's largest market for electric vehicles. But the country's domestic manufacturers, like BJEV, have a huge head start. By Jeffrey Ball

TECH **INSIDE BEIJING ELECTRIC VEHICLE'S** headquarters, a glass-and-steel complex on the Chinese capital's edge, a cafeteria awaits renovation so that cooks can crank out pizza and other Western fare for the posse of foreigners the company expects to hire. "We need to have a more international feeling," says Wang Shitao, a Chinese engineer who earned a master's degree in Germany in energy storage before returning to his country to ply his skills in its new and booming electric-car industry. "You cannot force them to eat Chinese food all the time."

Nor, the Chinese government has decided, can bureaucrats continue to aggressively steer Chinese electric-car buyers to domestic brands. The inescapable reality: Beijing Electric Vehicle needs a tune-up.

All but unknown outside its homeland, Beijing Electric Vehicle, or BJEV, is China's largest maker of pure-electric vehicles and the world's No. 2 manufacturer, behind Tesla. A decade old, BJEV owes its growth to state support.

But now the Chinese government is ratcheting back that aid. It's slashing customer subsidies for the cheapest electric cars, which are the bulk of BJEV's sales. And it's opening the country's electric-vehicle market to greater competition from the West's better-established automakers, a move widely seen as a bid to tamp down the global trade war.

As a result, BJEV must get a lot more sophisticated, and fast. Thus its plan to hire an army of electric-car experts from abroad.

Because the electric-car market in China dwarfs those of all other countries—China accounted for 60% of the 1.3 million electric-only cars sold globally last year, according to Bloomberg New Energy Finance—and because the growth in demand for electric cars is expected to outpace that for conventional vehicles, foreign firms see it as a fight for their

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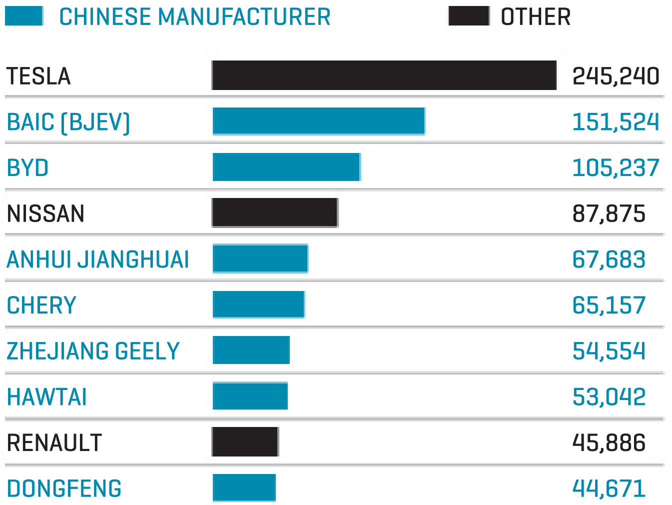

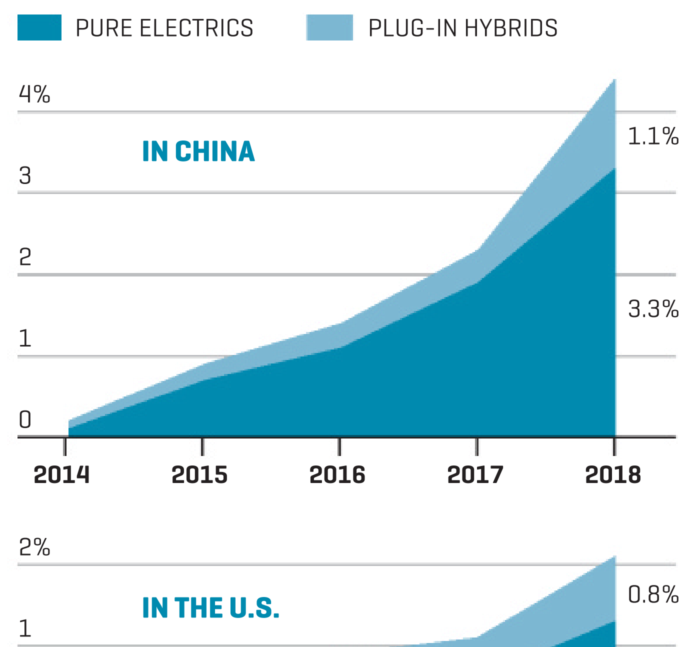

futures. Tesla, General Motors, Volkswagen, and BMW are ramping up their presence.

The Chinese electric-car race has big geopolitical, economic, and environmental stakes. For the planet, what happens in China will be the biggest test yet of whether electric cars can meaningfully displace gasoline cars, with potentially huge repercussions for the oil industry and the climate. For the world's conventional-auto giants, embarrassed by Tesla in the electric-car race's first stage—the one in the West—the scramble on Chinese turf will determine whether they can finally outflank Tesla's controversial CEO, Elon Musk. And for China, the competition will test whether the country's industrial push has advanced to the point where homegrown companies, such as BJEV, can best Western rivals in a still-fledgling industry in which global leadership has yet to solidify.

China's electric-vehicle market is forcing "the international automakers to accelerate their electric-vehicle strategies globally," says Kou Nannan, a Bloomberg analyst in Beijing.

BJEV, founded in 2009, is a unit of state-controlled Beijing Automotive Group, or BAIC Group, one of China's biggest automakers. In February, Ma Fanglie was named to lead the unit, which has around 6,000 employees. His predecessor left, the company says, for "physical and family reasons."

In written answers to questions, Ma acknowledges BJEV's challenges. With subsidies falling, he asks, "how can new-energy vehicles impress consumers?" As for the Western auto companies piling into China, their "brand accumulation and technical strength cannot be underestimated," he says. But BJEV knows the Chinese market and is scrambling to improve its vehicles, says Ma: "We believe that the competition between car companies is to see who has more blood and who is bleeding slower."

Pure electrics accounted for 3.3% of new passenger-car sales in China in 2018, up from 0.7% in 2015 and more than double the U.S. share of 1.3%, according to Wood Mackenzie. Together, pure electrics and plug-in hybrids accounted for 4.5% of China's market in 2018.

BJEV sold about 152,000 pure-electric cars in China in 2018, according to Bloomberg. That was nearly 50% more than the number of pure electrics sold by China's No. 2 manufacturer, BYD. Adding plug-in hybrids, BYD was China's top maker of vehicles that plug into a socket, selling 248,947 of them last

Some Chinese cities give electric-car owners green license plates, which bestow certain driving privileges. A showroom (far right) for BJEV, the biggest maker of pure electrics in China.

© IMAGINECHINA [2]

year. BJEV doesn't produce hybrids.

The Chinese government is mulling long-term targets for electric-car sales. China's Society of Automotive Engineers has said 40% of passenger-vehicle sales should be electrics or plug-in hybrids by 2030. Behind China's ambition are three strategic goals: combating pollution, curbing oil imports, and building competitive electric-car firms. Governments at every level have been pursuing the goals through carrots and sticks.

The carrot consists of big subsidies, which, in the case of some models, make buying an electric car half as expensive as it would otherwise be. By far the bestselling electric car in China in 2018, an econobox from BJEV called the EC, sold for about $8,000 after subsidies.

For many drivers, the stick has been at least as important. Traffic-clogged megalopolises such as Beijing have greatly reduced the number of new license plates they issue for conventional vehicles and have limited when such cars may drive in certain areas. But cities are issuing more electric-car license plates, which are green, while not restricting when electric cars can be used.

The wake-up call for BJEV was China's shifting electric-car subsidies to car models that are more efficient and go farther on every charge. The company is also grappling with the government's eliminating protectionist policies that coddled domestic firms.

China still requires that foreign automakers pay import duties if they manufacture the cars outside the country. But as of 2018, foreign companies no longer need joint ventures with Chinese firms to undertake local manufacturing and thus avoid tariffs.

Further unleashing the foreign competition is a Chinese requirement taking effect this year that any automaker selling petroleum-powered vehicles in the country must either sell a minimum number of its own electric cars—a number pegged to its total-vehicle sales—or buy so-called new-energy-vehicle credits from other automakers. It's an environmental mandate China modeled on one in California.

VW, which sold only about 8,000 electric and plug-in hybrids in China in 2018, according to Bloomberg, says it plans to sell an eye-popping 400,000 annually by next year and 1.5 million annually by 2025. Tesla, which resisted manufacturing in China when the country still required joint ventures, shifted strategy after the policy changes and broke ground in January on a factory in Shanghai, its first factory outside the U.S. Tesla says the plant will ultimately produce 500,000 electric cars annually.

Amid that onslaught, BJEV is scrambling. It has targeted selling 500,000 electric vehicles annually starting next year, and it is pursuing foreign markets. In a meeting room at the company's headquarters that, like others, is named for a major global city—in this case, Berlin—Wang, the BJEV engineer, explains that Chinese automakers have focused mostly on ancillary car features, like Wi-Fi, but still lag established auto giants on the basics, such as safety and high-speed handling.

On "the fundamental things, they have the experience," Wang says of Western rivals. "In the future, we need to care about the quality of the car—not only to say we are the cheapest." He adds, "We need to catch up." ■

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Inside 42's Paris campus, where students must endure a four-week-long admissions process.

IS 42 THE ANSWER?

A billionaire disrupter of the French telecom market had a radical idea: Build a computer programming school that has no books, no teachers, and no classes. Oh, and make it free. Six years in, has it worked? By Vivienne Walt

VENTURE

BACK IN OCTOBER 2016, James Aylor was scraping by, delivering pizza in Kansas City, having dropped out of college, abandoning his dream of teaching viola. "The voice in my head said, 'You have no career. No future,'" he says.

Then a friend mentioned he had heard about a new, tuition-free coding school 1,800 miles away in Fremont, Calif. Named 42, it required no computer skills or even a high school diploma, and dorm rooms were free. "I said, 'Yeah, whatever, ha ha, free,'" recalls Aylor, now 30. Still, he decided he had "absolutely nothing to lose." He sold his car and bought a plane ticket west.

When I meet Aylor a little more than two years later, he is in northern Paris, strolling through the lobby of the original 42 school, of which Fremont is an offshoot. The radical educational experiment is geared to solving the tech industry's chronic shortage of skilled programmers. With his pizza gig a distant memory, Aylor says he is now juggling potential jobs, weighing whether to join a company when he graduates this summer or launch a startup.

© PHILIPPE COUETTE

"There are so many possibilities," he says.

Back in 2013, I visited 42 for *Fortune* as its first batch of students was moving in—literally: Many had arrived in Paris with no money, rolling out sleeping bags in 42's factory-style campus. Takeout cartons and beer bottles littered the rooms. Standing amid the tumult, 42's founder, billionaire telecom exec Xavier Niel—one of the richest people in France—was thrilled. "We'll have some impact," he told me then.

Niel's brazen idea drew from his own experience. With no college degree, he taught himself coding and created programs (including a sex-chat app he sold for about $50 million) on France's pre-Internet Minitel service. He went on to found the publicly traded group Iliad, parent of the low-cost telecom company Free, and in 2017 opened the giant tech incubator Station F in eastern Paris. Niel, now 51, says he was increasingly convinced that France's traditional education ("the worst!" he says) boxed kids into preordained tracks, leaving them bored and uninspired; he felt the effects in his own companies.

The 42 school, which Niel built with $78 million of his own money, tries to shatter those conventions. It has no fees, teachers, or classrooms. Students work their own hours. If they need help, they ask each other or figure it out themselves. In keeping with the rebel spirit, the school's name refers to the counterculture classic *The Hitchhiker's Guide to the Galaxy,* which says "the answer to everything" is 42; the first building had a pirate's flag outside. About 1,800 students are admitted each year between the two campuses, chosen from about 3,000 who are accepted into 42's grueling monthlong boot camp called Piscine, French for "swimming pool." Those 3,000 are picked from the initial 40,000 people who take 42's online logic test every year.

The pirate's flag has gone, and there are only a few sleeping bags in the corridors. The walls display an impressive art collection, and President Emmanuel Macron, a cheerleader for the French tech industry, is a frequent visitor. Yet 42 still has the feel of a messy startup, with dozens of people at monitors and a stack of skateboards in the lobby.

But how much impact has 42 had, nearly six years in?

Niel is convinced that 42 has proved his point: that programmers need only two things to succeed—a grasp of logic and driving ambition. "You don't need to know anything to be able to code. You don't need to be good at math," he says, sitting atop Iliad's headquarters, with a sweeping view of Paris. "You can take anyone in the street, and"—he snaps his fingers—"they can become the best coder in the world." About 40% of the students have not graduated from high school. "The idea was you don't choose people by seeing if they can do something," Niel says. "You completely forget what they did before."

Indeed, 42 boasts impressive success stories.

Jasmine Anteunis, 26, joined 42's first intake after quitting fine-arts school at 21. Two years later, she created an artificial intelligence chatbot, Recast.AI, with two fellow 42 students. They sold last year to software giant SAP. Are you rich? I ask. "Ah, yes," she says, blushing. One of Anteunis's classmates, Balthazar Gronon, 25, left Paris in February for San Francisco, where he launched a blockchain company called Ashlar—in a sharp break from his original plan to be an economist, he says. And Niel says even old-style French companies like banks and fashion houses are now recruiting 42 students.

But in California, 42 has struggled for credibility since opening in 2016. It fills only about one-third of its capacity of 3,000 students. (To attract a greater number, the school now offers more frequent Piscine boot camps.) Niel, famous in France as a visionary entrepreneur, is unknown in the U.S. And ironically, a major hurdle for 42 appears to be that it is free—despite Americans being crippled by student debt. Says Niel, "When you are tuition-free, people think it is a fraud." ■

L'ENFANT TERRIBLE

XAVIER NIEL

AGE: 51

FROM: Paris

RISQUÉ: From sex chats to a stake in a chain of peep shows, Niel's business history has been colorful. He was convicted in 2006 for embezzling 200,000 euros from one of his sex shops.

HIS WAY: Niel is co-owner of the publishing rights to the song "My Way," popularized by Frank Sinatra, which was originally written with French lyrics.

NEWSMAN: To the chagrin of former President Nicolas Sarkozy, Niel was part of a consortium that bought the prestigious *Le Monde* newspaper in 2010.

FRANCOIS MORI—AP/SHUTTERSTOCK

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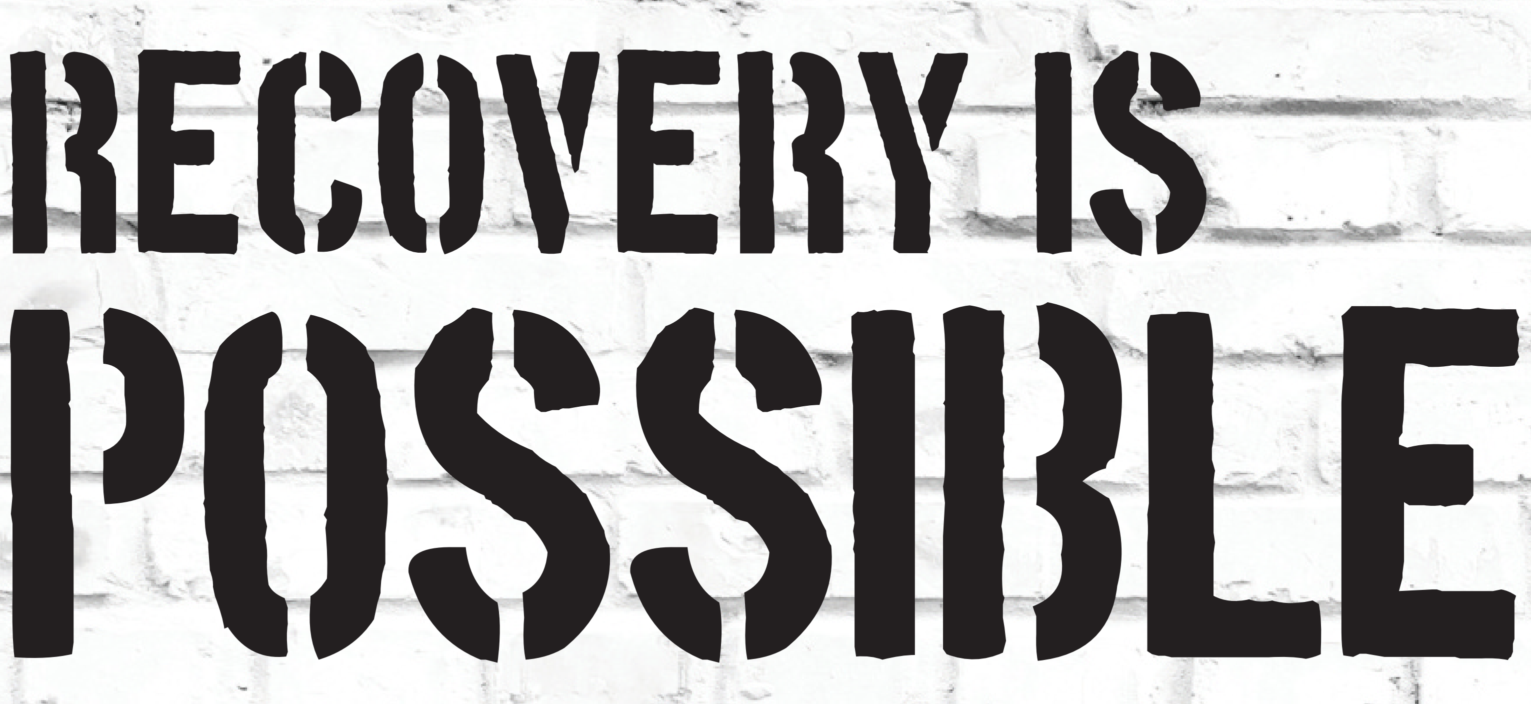

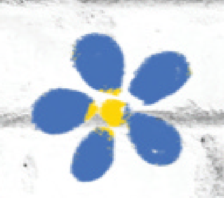

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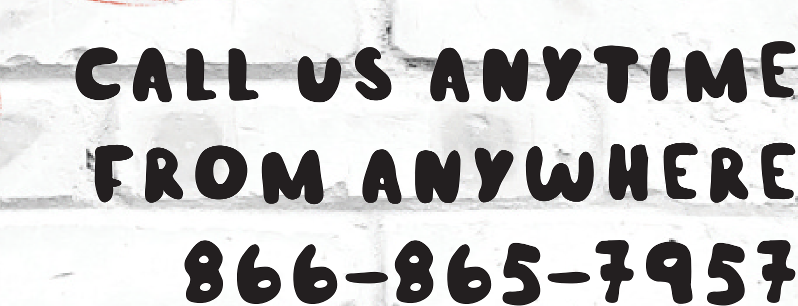

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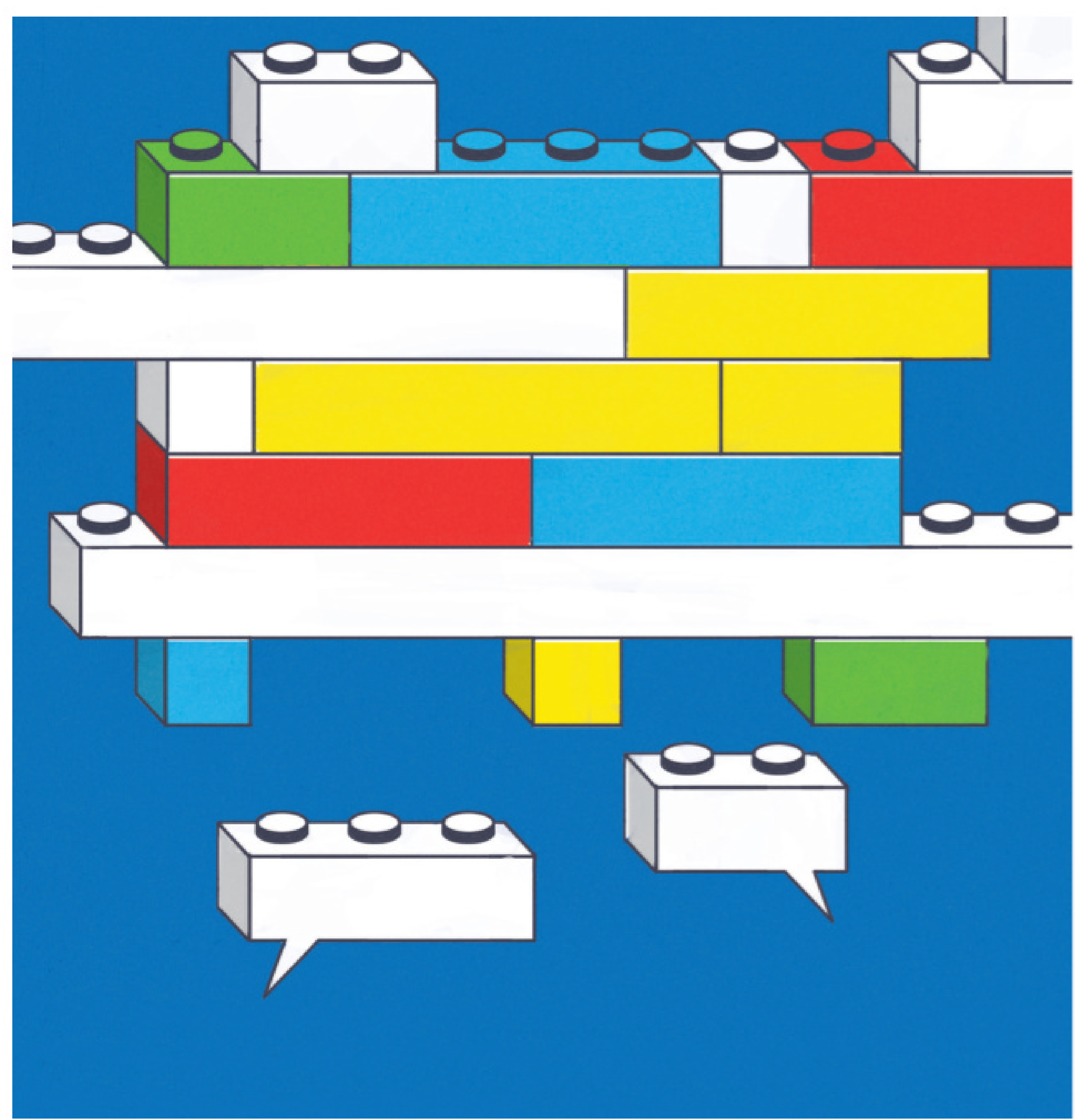


BETTING ON TECH'S BUILDING BLOCKS

The cloud-computing boom has seeded a crop of fast-growing companies that cater to software coders. How investors can profit from the pursuit of API-ness.

By Robert Hackett

INVEST **AMAZON GETS LOTS** of credit and flak for turning retail upside down; it also earns plaudits for its pioneering cloud-computing business. But in a still-unfurling development, the seismic shift that Amazon wrought in the IT world has spawned a whole new business category—providers of "APIs"—that has already begun paying off for a few prescient investors.

Amazon Web Services, the tech giant's cloud-computing business, began as a way to boost affiliate marketing and power e-commerce sites. But within a few years, the project had incubated a grander vision. Amazon bet—correctly—that it could make a killing providing basic IT functions to all kinds of businesses. The pitch: Don't worry about all that tedious infrastructure upkeep, or about computation, storage, or bandwidth. We'll manage it for you.

The idea became one of Amazon's primary growth drivers, contributing revenues of $25.6 billion in its most recent fiscal year and growing at a healthy 47% clip—and has become lucrative for rivals like Microsoft and Google too. But the cloud-computing boom has also generated a powerful knock-on effect: an API-related Big Bang.

APIs, or application programming interfaces, are pieces of technology that act as bridges between software applications. APIs enable connection, like electrical outlets porting to power grids: They're the conduits through which data flows and interacts. "There's been this saying for the longest time that software is eating the world," says Rishi Jaluria, an analyst at D.A. Davidson & Co. Now, he says, "APIs are eating software."

For corporate customers, API providers are paring down the hulking software packages that characterized the first generation of enterprise tech sold by the likes of SAP, Oracle, and IBM. Purveyors of APIs reduce these packages to their simplest component parts: Lego-like modules for communications, payments, content management, electronic signatures, and more. Customers get the same proposition that made cloud computing so attractive. Someone else handles the humdrum tasks, so they can focus on what matters. Uber and Lyft, for instance, owe much of their breakneck growth to the fact that they could turn to APIs for navigation, sign-up, and transactions.

The prosperity flows both ways. As the tech companies they serve expand, API providers get to hitch along for the ride. Right now, few API-oriented companies are profitable, but as their data pipes and tools catch on, the leading

▲ ILLUSTRATION BY **CHRIS GASH**

providers are likely to enjoy “network effects,” becoming the dominant, go-to choices in their categories. Because API providers cater to developers, they’re able to build followings inside and across organizations of all sizes, with negligible marketing costs and powerful economies of scale. And as their APIs get used more, the providers will get paid more.

“People often call us plumbers,” says Sima Gandhi, who heads business development and strategy at Plaid, which uses APIs to connect bank accounts to fintech applications such as payments app Venmo and investment brokerage Robinhood. The startup claims to have hooks in one out of four bank accounts in the U.S., despite most consumers never having heard of it. “We do the dirty work,” Gandhi says.

BECAUSE THE API TREND is so new, most of the action remains in the private markets. But a growing field of publicly traded companies offers options for savvy investors.

Twilio **(TWLO, $122)**, whose CEO, Jeff Lawson, is a veteran of Amazon’s cloud business, derives most of its revenue from communications APIs—linkages that help businesses contact customers through text messages and phone calls. It’s a steadily growing category, and Twilio’s stock more than tripled over the past year as the product took off. For those seeking to invest in the communications API trend at a lower valuation, Patrick Walravens, an analyst at JMP Securities, recommends **Bandwidth** **(BAND, $56)**, a telecom concern whose business fundamentals are “not particularly well understood yet” by the market. Twilio trades at a multiple of around 18 times last year’s revenue of $650 million; Bandwidth trades at just five times its $204 million in revenue.

APIs are also making an impact in payment processing, where they help connect merchants, banks, and consumers. The most mature API player in this market is Stripe, which is privately held. But public-market investors can get exposure to a fast follower, **Adyen** **(ADYEN, $746)**, a Netherlands-based payment processor that brought in $1.95 billion last fiscal year and counts Uber and Spotify among its customers.

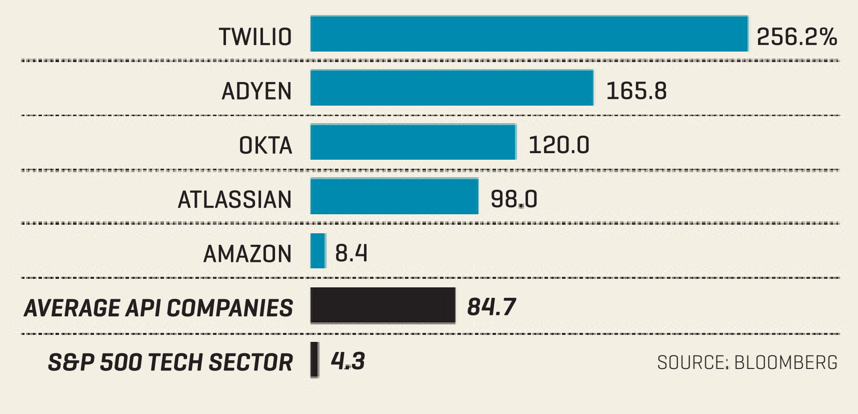
Another up-and-comer is **Okta** **(OKTA, $85)**, which sells “identity management” tech that eliminates the hassle of passwords. The company originally sold identity products for use just in the workplace, says Todd McKinnon, Okta’s CEO, but soon found its corporate customers clamoring for a way to verify the identities of their customers—a market McKinnon believes could grow to be bigger than the workplace one. In addition to the initial product, Okta now sells a customer-focused, API-powered product to companies ranging from Adobe to MGM Resorts. The company’s share price has zoomed more than 260% since its 2017 IPO, but JMP’s Walravens recently wrote that its valuation “fairly captures the company’s impressive growth.”

Atlassian **(TEAM, $107)**, an Australian outfit, specializes not in providing APIs but rather in offering developers the tools they need to work with the APIs other companies supply. Its Jira product, for instance, helps coders and project managers track software progress, bugs, and other issues, while its Confluence tool enables developers to collaborate on coding. (As Twilio’s Lawson puts it: If your coders ran a cookie factory, Atlassian would supply the baking sheets.) Its fan base is growing; in its 2018 fiscal year, revenue rose 41% over the year prior, to $874 million, and it has plenty of room to expand in the $20 billion–plus market for IT operations and service.

Small and new as they are, these API-first businesses are relatively speculative bets. But Byron Deeter, an investor at Bessemer Venture Partners and an early backer of both Twilio and SendGrid, an API-focused email business that Twilio recently acquired, believes their turbocharged business models are only now coming to fruition. “You’re going to see a lot more of these companies in the public markets in the years ahead,” he says. ■

RAPIDLY UNFOLDING DEVELOPMENT

Companies that focus on making APIs—connective components for software developers—have produced blockbuster returns recently. And API services have also boosted the results of bigger tech companies like PayPal and Amazon.



“AVERAGE” GROUP IS A BASKET OF 12 API-RELATED STOCKS, INCLUDING SENDGRID, WHICH WAS ACQUIRED BY TWILIO FEB. 1, AS WELL AS DROPBOX, DOCUSIGN, AND ADYEN, WHICH EACH WENT PUBLIC LESS THAN 12 MONTHS AGO.

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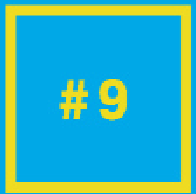

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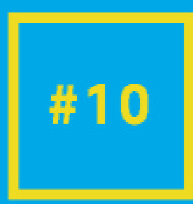

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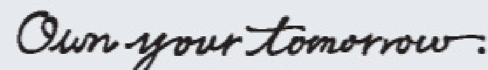

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The gateway drug: Handbags—not perfume—are bringing customers into luxury retail.

TAKING BACK FIFTH AVENUE

A $250 million revamp of Saks' Manhattan flagship is the tip of the spear in the hypercompetitive department store wars.

By Phil Wahba

ASCENDING A SLEEK NEW MULTICOLORED escalator, designed by Dutch architect Rem Koolhaas, Saks Fifth Avenue president Marc Metrick is a man vibrating with excitement ahead of the store's grand unveiling. The escalator's bright red and blue hues and a large LED ceiling, which creates the illusion of a blue sky, pop in sharp contrast with the gray curtains used to cordon off a dusty construction area. Change is afoot on the ground floor of one of Manhattan's most iconic department stores.

This sense of theater epitomizes what Metrick—who has been president of the HBC-owned Saks since 2015—is convinced the company has to offer today's shoppers, particularly at its 650,000-square-foot New York City flagship.

PHOTOGRAPHS BY **KARSTEN MORAN**

The dazzling new escalator connects the street level—for decades home to a beauty area teeming with sales staff trying to spritz you with perfume—to an opened-up second floor. The new street-level space is a 53,000-square-foot emporium for leather goods and handbags, what Metrick calls the "gateway drug" for luxe shoppers. By late summer of this year, the renovations will include The Vault on the lower level, once a storage basement but soon to be home to Saks' priciest jewelry, like Chopard watches.

The buzz of activity comes at a time when Saks has some wind in its sails, after going through a rough patch three years ago. Sales were declining quarter after quarter. It was losing market share, and the grande dame of New York luxury, a fixture since 1924, had lost much of what made it stand out.

But in the past two years, sales have grown seven out of eight quarters, and recent results have bested those of two major rivals—Nordstrom and Neiman Marcus.

The luxury market might be crowded, but it is booming. According to Bain & Co., the U.S. personal luxury-goods market rose 5% last year, to $85 billion.

A run-of-the-mill store just wouldn't do, so for Saks, a $250 million multiyear remodel of the Fifth Avenue location was in order.

"There is no better time to cement your strategy as a luxury retailer than when you're about to put a quarter of a billion dollars into your flagship store," says Metrick.

While Saks isn't installing anything outlandish, like the indoor ski hills it featured in the 1930s (try getting a CFO to sign off on that today), it's still trying to channel that spirit as it looks to make the Fifth Avenue store a modern-day destination.

Marc Metrick ascends the Rem Koolhaas–designed escalator to the store's new cosmetics area.

"AFTER YEARS OF TRYING TO BE ALL THINGS TO ALL PEOPLE, SAKS DIDN'T STAND FOR ANYTHING."

—MARC METRICK

Last year the beauty section moved up a floor and gained 40% more space, offering new amenities like facial workouts and anticellulite treatments. The area, historically on street level to generate shopper visits, offers clean sight lines with more natural light from outside, a feature all floors will have by 2021.

Shopping isn't the only component of Metrick's vision for Saks as a New York destination: L'Avenue, a high-end Philippe Starck–designed restaurant, recently opened on the ninth floor. It's the only outpost of the Paris eatery that attracts A-list names like Rihanna and Beyoncé.

While Saks is thriving now, it had been in turmoil almost since 2013, when it was bought by Canadian department store conglomerate HBC for $2.4 billion.

There was turnover in the C-suite, strategy lurches, and the prevailing opinion that Saks was an icon adrift. So when Metrick, now a 23-year veteran of the brand, took the reins in 2015, he immediately began with a deep dive into customer perceptions. Among the humbling discoveries: Saks and its archrival Neiman Marcus were interchangeable in shoppers' eyes.

"After years of trying to be all things to all people, Saks didn't

Diners at L'Avenue, a Philippe Starck–designed eatery on the store's ninth floor (left). No more spritz: The ground floor is home to leather goods.

stand for anything," Metrick recalls.

The problem, he says, was that Saks had come to play second fiddle in shoppers' minds to the brands it sold. Case in point: Practically the only time Saks and its square logo were front and center in advertising was when it was holding sales events. Otherwise, Saks was an afterthought, its logo relegated to the bottom of a fashion brand's billboard. Metrick's rallying cry for his troops has since been to make Saks the "hero" in customers' eyes. "The goal is for people to say, 'I got this at Saks,' or 'Have you been to Saks lately?' "

That's no small order, what with some 85% of any luxury department store's offerings overlapping with those of its rivals. And brands themselves are opening more of their own boutiques and taking control of how their wares are presented, often without the discount culture that has pervaded department stores for the past decade.

But luxury brands, particularly smaller ones, can do only so much with their own sites and stores in reaching a wide audience. Department stores offer high foot traffic and the ability to provide brands with highly detailed customer data, including which other brands shoppers like.

Yet the question remains: If you want to buy a Gucci sweater that is available at Saks, Neiman, Nordstrom, a Gucci boutique, or online at Net-a-Porter—why choose to buy it at Saks?

That's why Metrick sees reinventing the flagship as so important, with many ideas being adapted to the 40 other stores in the fleet.

E-commerce, where Nordstrom is seen as a best-in-class operator, is another area of Metrick's focus. In 2017, Saks introduced Salesfloor, where an actual salesperson working at a store—and not a chatbot or an overseas call-center operator—is available online to assist shoppers. The result: Items bought via Salesfloor have drastically lowered return rates.

"She's thinking about every other online experience she's having today, and is Saks as easy as all that?" says HBC CEO Helena Foulkes of the prototypical Saks shopper.

Saks was recently reminded of how hard it is to win over the modern shopper, even on its home turf. In January it closed a women's store in lower Manhattan after only two years, a move indicative of the company's renewed focus. "The next dollar I invest has to be in the place with the most upside," says Foulkes.

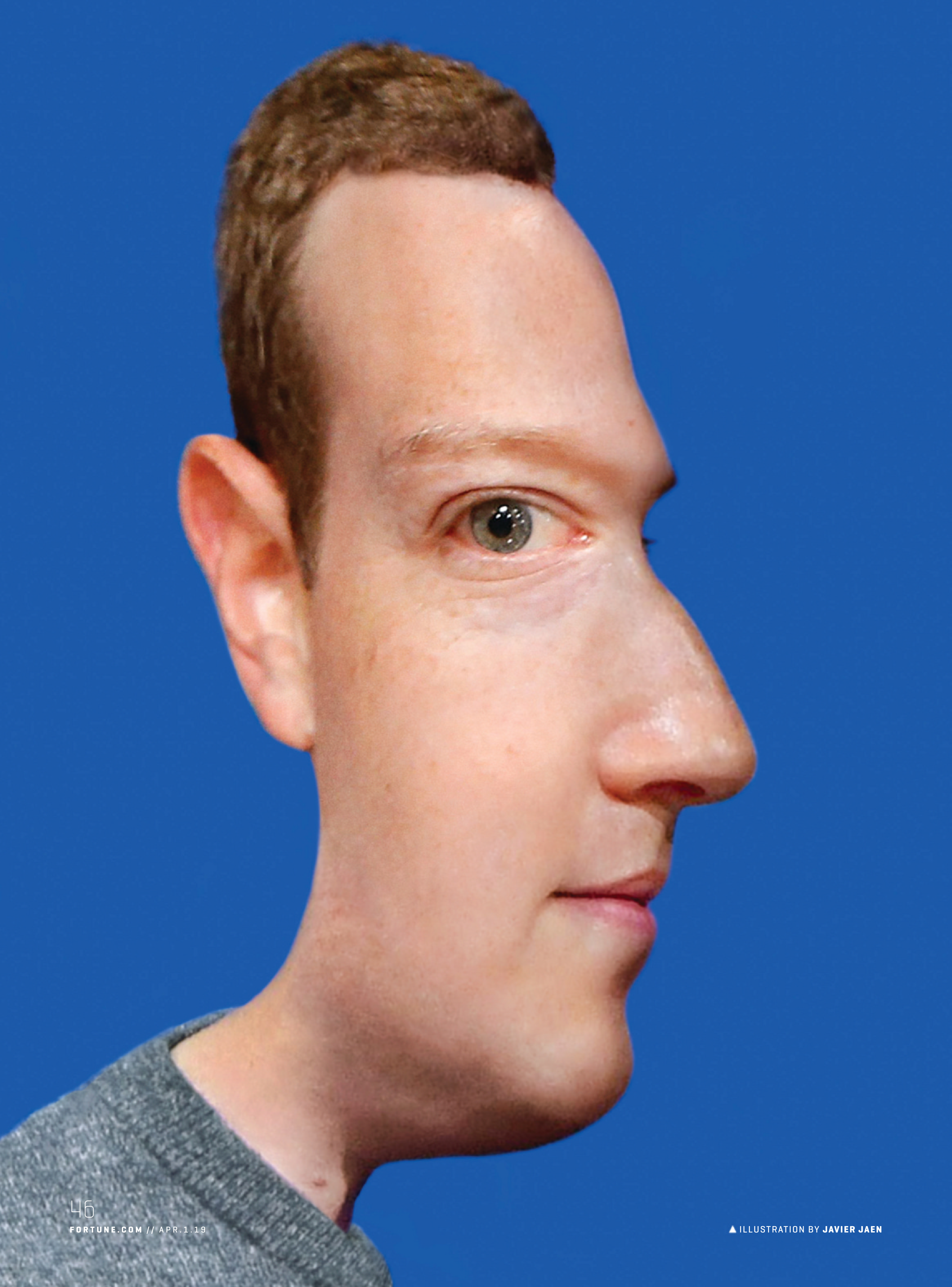
That means doubling down on its best-performing business—Saks—particularly, the flagship. Though HBC doesn't break out individual stores' numbers, the Manhattan flagship generates at least $600 million a year, or about 15% of Saks' total sales.

"The Saks brand is only going to be as strong as that Fifth Avenue store," says Scotiabank retail analyst Patricia Baker. Still, Saks doesn't want its so-called branches to be seen as backwaters. So edgy brands like Vetements and Jacquemus are now sold at other stores too, not just in Manhattan.

Another idea that has been adapted to other branches is The Collective, an area that focuses on up-and-coming brands, to solidify what Metrick calls "Saks' fashion authority."

"Our role in the fashion ecosystem is to be the place to introduce brands to our consumer," he says.

Under Metrick and Foulkes, the company has a much faster metabolism. Fail fast, and move on. "The luxury consumer is certainly less forgiving and less patient than they used to be," Metrick says. Making Saks' elevation of the retail experience all the more important. ■



▲ ILLUSTRATION BY **JAVIER JAEN**

About Face

MARK ZUCKERBERG'S DORM-ROOM CREATION is worth half a trillion dollars, has 2.3 billion regular users, and dominates its corner of the online advertising industry because its ads are so effective. Now **Facebook** is under attack from regulators, competitors, and privacy advocates—even as its growth slows. The challenge: mollify its critics without destroying its business model. *Fortune*'s inside look at an impossible dilemma.

By MICHAL LEV-RAM

ILLUSTRATION SOURCE PHOTOGRAPHS: GERARD JULIEN—AFP/GETTY IMAGES AND LACHLAN CUNNINGHAM—GETTY IMAGES

MARK ZUCKERBERG WANTS TO TALK about how Facebook is changing.

It is early February, and the 34-year-old CEO sits on a couch in his glass-walled conference room in Facebook's newest complex, a Frank Gehry–designed structure that features a 3.6-acre rooftop garden and 40-foot redwoods. Zuckerberg summarizes Facebook's changes around "four big categories that we've focused on," all with the subtext of the immense criticism his company has faced over more than two incredibly difficult years. One category, he says, is "content governance, helping to balance free expression and safety." He continues, "Another is principles around data privacy and, in a world where everyone is sharing a lot of information, what are the right ways to go about protecting that and giving people control." Zuckerberg's last two categories are "digital health and well-being," a nod to device proliferation and screen-time overload, and "election integrity and preventing interference."

The talking points amount to Zuckerberg's apology tour for all the damage Facebook has wrought. On the way to building an empire worth half-a-trillion dollars, he and his company have connected friends old and new, sure, but they have also inadvertently found themselves in the middle of controversies from hate speech to data breaches. Zuckerberg wants to show that he gets it. Facebook, he says, "is moving from a reactive model of how we're handling this stuff to one where we are building systems to get out ahead."

A month later it becomes apparent that Zuckerberg has been rehearsing his lines, the tech-mogul equivalent of a comedian trying out material at open-mic night. In a much-heralded post on Facebook in early March, Zuckerberg announced his company would build new privacy-friendly messaging products, moving from a "town square" approach to one more akin to a living room conversation. "People should have simple, intimate places where they have clear control over who can communicate with them and confidence that no one else can access what they share," he wrote. In other words, they should have a place to communicate that is nothing like Facebook.

Change is a complicated topic for Facebook. On the one hand, it certainly is doing a ton to address its problems, like hiring tens of thousands of workers to police its content. Yet on the other hand, for the foreseeable future, Facebook will remain exactly what it has been over the past decade-plus of its meteoric rise: a publishing platform that gathers data on its 2.3 billion users for the benefit of its marketer customers, who helped Facebook record $56 billion in revenues last year. Facebook may be changing, but it aims to preserve what it's got until it figures out a way to replace the business too much change would jeopardize.

Facebook's fiddling with its business model is also more pressing than many realize—and not merely a response to the scrutiny the company faces. Facebook's core business is slowing dramatically, even as a combination of potentially hamstringing regulation and rejuvenated competition looms. Its flagship product, widely known as Facebook Blue, is losing popularity, especially among younger audiences. And user growth has slowed in the rich countries where the company makes the bulk of its money. Sure, Facebook's 2018 revenues grew at a torrid pace for a company its size, gaining 37%. But that reflects a rapidly declining growth rate, from 54% in 2016 and 47% in 2017. Wall Street projects continued deceleration, to 23% this year and 21% in 2020, according to S&P Global.

Zuckerberg, without commenting directly on the deceleration in Facebook's revenue growth, says he aims to chart a dual course, one that protects Facebook's current offerings and another that finds new ways to make money, through services like payments and e-commerce. "We are trying to build services that everyone can use," he says, adding that the best way to do this is to keep them "affordable and ideally free" and thus funded by advertising, Facebook's existing business. Asked how his new interest in privacy and smaller-group communication will become a business, he is tough to pin down, either because he doesn't yet know or isn't ready to say. (His March manifesto is no more specific.) Users, he says, "want to and rightfully should be able to understand how their information

NOT STANDING STILL: Mark Zuckerberg (center) at the European Parliament in Brussels in May 2018.

is used and have control," and Facebook will build them products to give them that control. Says Zuckerberg: "We need to go do that."

"WHICH ONE OF THESE is broccoli and which one is marijuana?"

Mike Schroepfer, Facebook's chief technology officer, is pointing to two side-by-side images on his laptop, asking me to identify the "good" from the "bad." The answer isn't obvious. Both pictures look convincingly cannabis-like—dense, leafy-green buds that are coated with miniature, hair-like growths, or perhaps mold. Finally, I make a semi-educated guess: "The one on the left is marijuana?" Schroepfer nods approvingly.

The demo is an illustration of how Facebook is using technology, specifically artificial intelligence, to clean up its act. A.I., says Schroepfer, is more accurate than humans. He says Facebook's A.I. system was 93.77% sure the picture on the left was marijuana and 88.39% sure that the picture on the right was broccoli. And it's faster by far than a human. "It took you more than a second," he says. The company's technology "can do this in hundredths of milliseconds, billions of times a day."

People are as much a part of Facebook's solutions to its problems as computers. It has tripled its number of content moderators, contractors it hires to monitor postings in Facebook's News Feed section, from 10,000 in 2017 to 30,000 today. At the higher end of the organizational chart, Facebook also has beefed up the hiring and redeploying of experts who address specific issues with the information its users see. Molly Cutler, Facebook's former associate general counsel, now leads a "strategic response" team that meets weekly with chief operating officer Sheryl Sandberg. Samidh Chakrabarti, the company's

Says analyst Gene Munster: "They like talking about [policing content] because that's what's fixable."

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WE HEAR YOU: Sheryl Sandberg during a U.S. Senate Select Committee on Intelligence hearing on foreign influences in social media in September 2018.

head of civic engagement, has shifted his focus from voter registration to preventing election interference. Facebook has reassigned engineers in its once separate "safety and security" group to be embedded in individual product teams.

Such fixes are real, yet they are designed to improve Facebook, not to fundamentally change it. Removing terrorist propaganda is a crowd pleaser, argues Gene Munster, a veteran analyst with Loup Ventures, especially compared with the thornier issue of what Facebook does with its users' data. "They like talking about that because it's fixable," he says.

In fact, Facebook argues that beyond the bad actors it unintentionally allowed onto its network, it doesn't even have a problem to fix. Instead, it maintains that if only its advertising model were better understood, particularly by the public, its problems would be diminished. "It is core to our business," says Sandberg, of Facebook's holy trinity of user data, advertiser payments, and free content. "And it is the hardest to explain."

Sandberg works in the same building as Zuckerberg, and her conference room has a name: "Only Good News." It is either a wry joke about what she expects to hear from visitors or the greatest example ever of corporate wishful thinking. She and Zuckerberg vigorously push back on the notion that Facebook "sells" user data to marketers. What Facebook allows is the hypertargeting of anonymized users on behalf of marketers so that Facebook and its paying customers can profit from that data. "The actual inherent business model is really strong and much better than any other," she says by way of explaining why Facebook won't—indeed, cannot—give it up. What's more, Facebook sees its business model as a win-win. "It's much better than selling subscriptions, which only rich people can afford. You cannot have 2.7 billion people on a service if you charge. For a lot of the people who use our services, even a dollar would be out of range."

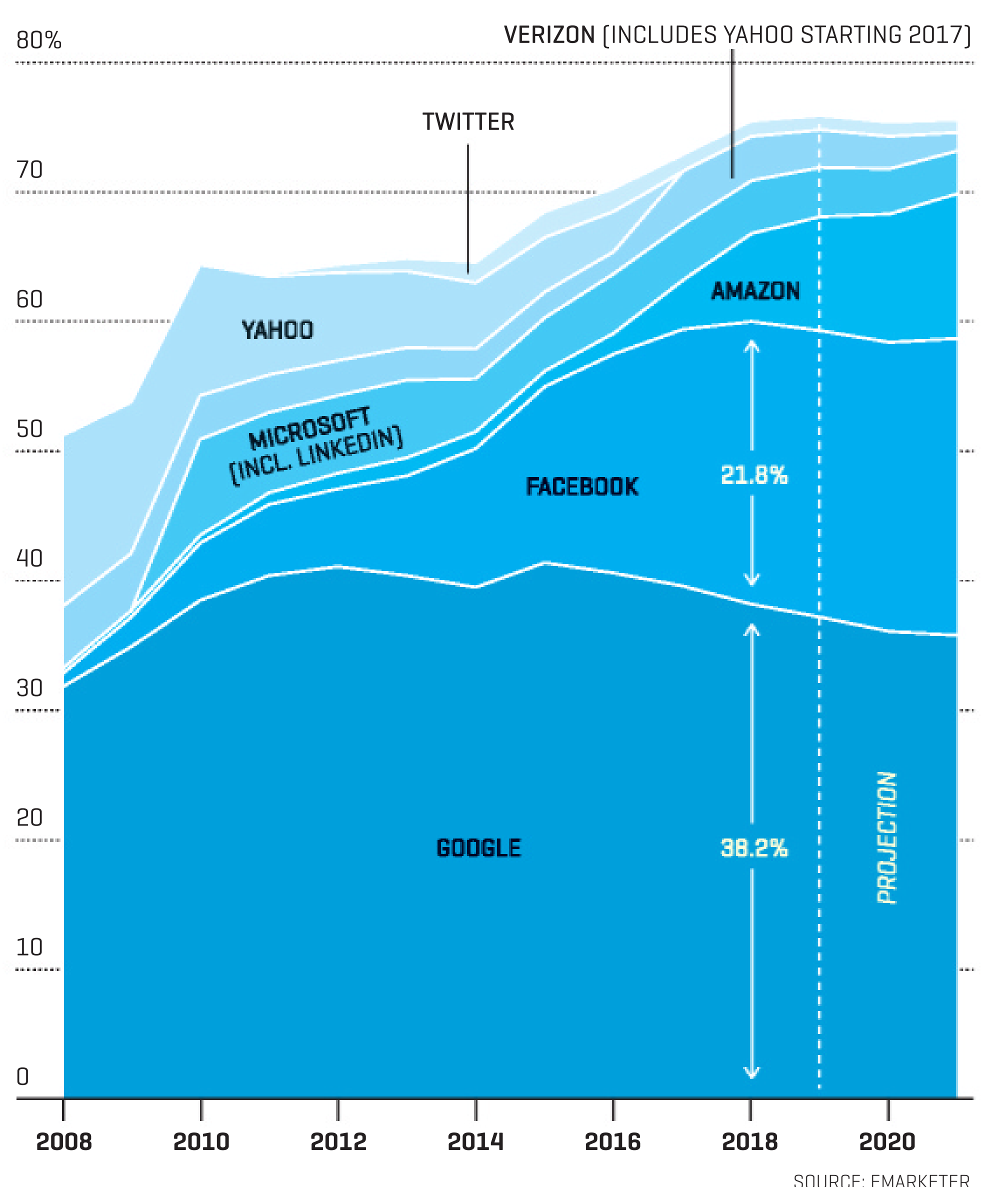
"It is core to our business," says Sandberg, of Facebook's business of ad sales, user targeting, and free services.

Whether or not the masses can pay to use online services, Facebook undeniably faces a rich world/poor world conundrum. Its growth is in the latter, but its profitability lies in the former. Last year the number of overall users grew 9%, much of the growth coming from outside its mature markets. Facebook said it makes an average of nearly $35 quarterly on each user in the U.S. and Canada, more than 10

© TOM WILLIAMS—CQ ROLL CALL/GETTY IMAGES

times what it collects in the Asia Pacific region. From a financial perspective, at least, the growth is in the wrong part of the world. "We expect that user growth in the future will be primarily concentrated in those regions where [average per-user revenue] is relatively lower," the company said in its 10-K annual report, filed in January. Sandberg professes to be unconcerned about the trend. "We don't really prioritize countries and user growth based on monetization opportunities," she says. "We want to connect everyone."

The geographic mix is just one macro issue buffeting Facebook's business. Its newer enterprises, including Instagram (purchased in 2012 for $1 billion) and WhatsApp (acquired for $22 billion in 2014) haven't yet translated into big revenue opportunities, though Instagram has been growing rapidly. WhatsApp, in particular, has huge global reach—it has 1.5 billion users worldwide—but no obvious business model. What began as Facebook .com, the original Facebook, has become positively becalmed. "The majority of growth is coming from Instagram, with core Facebook revenue growth likely to hit high single digits sometime next year," Stifel analyst Scott Devitt writes to clients. He says other Internet companies make for better investments.



IN 2012, USAMA FAYYAD enlisted two French Ph.D.s in an ambitious project. Their task was to figure out just how accurately Facebook could determine an individual user's purchasing behavior, based on the data available to the growing Silicon Valley company, which had about a billion users at the time. He made himself the subject of the study.

Fayyad was no random sample. Nearly a decade earlier, he had been Yahoo's first chief data officer after the then-booming Internet company acquired his data-mining startup, DMX Group. Yahoo grew its ad business from $20 million to $500 million during Fayyad's time there, pioneering the use of behavioral targeting of users. Now, as the chief technology officer of Blue Kangaroo, a personalized shopping app for mobile devices, he was trying to assess the effectiveness of Facebook's ads. (Spoiler alert: They were, and are, extremely effective.)

Because of his insider's wariness of sharing too much personal data online, Fayyad's own digital footprint on Facebook was limited. He had created a Facebook account soon after non–college students were allowed to, in 2006, but he had very few defining details on his page. Fayyad hadn't joined any groups and didn't comment on other people's posts. And while he had accrued several thousand "friends," the vast majority weren't people he regularly interacted with. As it turned out, Facebook's knowledge of the habits of Fayyad's acquaintances was more than enough to guess the kinds of purchasing decisions he was likely to make. "The shopping 'signal' for me was pretty strong," he says. "Your friends are very likely to like what you like."

In the years since Fayyad's study, Facebook's ability to target customers has only improved as its data sources have grown. Much of that

CONTENT COP: Mike Schroepfer, Facebook's chief technology officer, onstage at Facebook's F8 developers conference in San Jose in 2017. Facebook is deploying artificial intelligence to help root out unwanted content from its sites.

© STEPHEN LAM—REUTERS

additional data has come from Facebook itself, via new features like Facebook Live, its live-streaming video service, or the launch of Reactions, a more nuanced version of the Like button that allows users to express love, sadness, anger, and other emotional responses to content on the platform. (The videos that users watch and their reactions to all sorts of content can tell marketers a lot about who they are.) But the company also accumulated all sorts of other data sources from third-party providers eager to share the spoils. Facebook proved unable to control how the mix of third-party information and its own data got used, such as when political researcher Cambridge Analytica violated Facebook's rules, the company says, to harvest and act on Facebook user profiles.

The ensuing firestorm began to chip away at Facebook's credibility—even with the marketers who get so much value from the ads they buy on its platform. Facebook then hurt more than its reputation when it decided to cut off the third-party data providers. "They really shot themselves in the foot," says Allen Finn, a marketing specialist with online advertising consultancy WordStream. "They've dampened the ability to do ad targeting following Cambridge Analytica."

The changes have hurt—but have not crippled—the effectiveness of Facebook's ads because there are ways clever ad-tech specialists can combine Facebook's data with third-party data. "As these changes took place, we had to renavigate a little bit," says Laura Joukovski, chief media officer at TechStyle Fashion Group, an online retailer.

Facebook believes one way to improve trust on the part of users is to help them better understand Facebook itself. The theory is that if consumers understand how ads work, they'll continue to view them as a positive aspect of the Facebook experience. "Consumers—and it's not their fault—do not understand how digital advertising works," says Carolyn Everson, vice president of global marketing solutions. One of the ways Facebook is trying to shed light on its advertising model is by letting users click on individual ads to find out why they're being put in front of them. But the "Why am I seeing this?" button doesn't go into much detail, providing cursory information such as suggesting a retailer wants to reach people of a certain age in a given location. Facebook says it is still working out the kinks to the "Why am I seeing this?" feature and is in the process of allowing for much greater transparency and data controls. For example, it has announced it will offer a Clear History button that gives users the ability to erase their activity, much as web browser software has allowed for years.

The tweaks add up to just enough changes, more grist for the argument that Facebook is adapting—but only as little as possible.

IF FACEBOOK DOES CHANGE in more fundamental ways, it will be because it has to, not because it wants to. In 2020, the first-ever state data-privacy law will take effect in California, unless Congress can hurriedly pass a law to preempt it nationwide. The so-called California Consumer Privacy Act (CCPA) is one of the most stringent sets of rules that could soon put unprecedented restrictions on Facebook and companies like it. The law would give consumers much more control over their data, allowing them to see what online infor-

mation is being collected on them and how it's being used. They'll also be able to hit "delete" on their online information—a kind of Clear History button but for the entire Internet.

It's a high bar that pretty much no one in the tech industry wants to meet. California Governor Gavin Newsom wants to take it a step further. "I applaud this legislature for passing the first-in-the-nation digital privacy law last year," he said in his first State of the State Address in mid-February. "But California's consumers should also be able to share in the wealth that is created from their data."

Newsom's proposal is a "data dividend" that would require Internet companies to pay users for use of their information, and he's not the only one supporting it. Some, like Democratic 2020 presidential candidate Elizabeth Warren, are calling for companies like Facebook to be broken up. At this point, Facebook's best hope is that federal regulations come together faster than state-led laws, as the Internet industry hopes the fed rules will end up being more lenient.

Either way, the upcoming restrictions will have a lasting impact on Facebook. The company is already seeing the repercussions of the European Union's General Data Protection Regulation (GDPR). The new laws aim to give European consumers more control over their online information, requiring companies to gain consent from users before utilizing certain types of data. Failure to comply can result in fines up to 4% of a company's annual revenue—more than $2 billion, in Facebook's case. Even worse, the laws can cut into the company's ability to sell targeted ads. "With GDPR," says Sandberg, "there's a percentage of people in Europe that have opted out of certain kinds of targeting. Those ads are going to be less relevant." In other words, the Internet industry, including Facebook, already is taking a financial hit there.

The regulatory changes promise to have a cumulative effect. Historically, what advertisers use Facebook for is its broad reach and extremely specific targeting capabilities," says Debra Aho Williamson, principal analyst with researcher eMarketer. "It is true that those targeting capabilities are starting to be chipped away from GDPR." It's a process that could accelerate with similar moves around the world, including in Washington, D.C. Says Stifel's Scott Devitt: "Facebook's management team has created too many adversaries—politicians, regulators, tech leaders, consumers, and employees—to not experience long-term negative ramifications on its business."

"California's consumers should . . . be able to share in the wealth that is created from their data," said Gov. Gavin Newsom.

Regulation won't kick in overnight, but already competitors are capitalizing on Facebook's vulnerabilities. For the first time, it has viable rivals in addition to arch-nemesis Google. There's Amazon, which has incomparable purchasing behavior data on its customers, and TikTok, the music-video app that recently passed 1 billion downloads, many by customers much younger than Facebook's aging users. (Popularity with youngsters brings baggage: The Federal Trade Commission recently fined TikTok $5.7 million for violating child privacy laws.) All of this adds up to a strange new world for Facebook: There is unprecedented scrutiny on its slowing yet moneymaking core product and more obstacles than ever before to innovating quickly.

T

THE DISCUSSION OF FACEBOOK'S travails often toggles back to its past travails and what a canny, wise-beyond-his-years operator Mark Zuckerberg repeatedly has proved to be. He resisted early calls to sell his company. (Yahoo offered $1 billion in 2006.) He weathered user outrage over various design changes. In 2012 he successfully converted Facebook from a desktop-PC web program to a mobile app, a feat that required a complete retooling of its development process.

Facebook has already circled the globe looking for users. It has saturated the markets that are most profitable for the company, and now it needs to turn to additional ways of making money. If the future is in private messages or pictures that auto-delete, then Facebook wants to be there too. "I've always tried to run the company in a way that we're willing to take on more costs or lower revenue … in order to get to what I think will be the better thing over time," he says, previewing the painful changes the company's new products will require. "But I just think getting to the right model over time is going to help build a stronger community." Make no mistake. Zuckerberg doesn't just mean stronger for users, or society, or lawmakers. He means stronger for Facebook. ■

SPONSORED CONTENT

DECONSTRUCTING THE GAME

BRINGING CLARITY TO THE COURSE—AND THE BOARDROOM—MEANS ELIMINATING THE JARGON.

WHO COULD BLAME PGA TOUR SUPERSTAR Rickie Fowler for being frustrated? When a caddie leans in to offer the golfer advice on an upcoming shot, it's riddled with useless business clichés such as "square the circle" and "think outside the box." Exasperated, Fowler growls, "Just give me the 6."

This colorful exchange, seen in a recent commercial from audit, tax, and advisory firm Grant Thornton, the Official Professional Services Provider of the PGA TOUR and a Proud Partner of THE PLAYERS Championship, is thankfully fictional, but the message behind it is all too real. In golf, like in business, jargon rarely helps people make better decisions. That's why Grant Thornton is committed to providing clients with clear, useful advice, free of clichés and bland buzzwords. Their approach—known as Status Go—recognizes that it takes fresh thinking and new ideas to move business forward. For organizations looking for solutions that make sense, jargon won't cut it. Buzzwords don't solve problems—in the C-suite or on the green.

Unfortunately, like many industries, golf and professional services can be veritable minefields of jargon. Whether on the course or in the corner office, everyone is seeking an edge, a way to improve performance and outcomes. All too often, what we find is stale thinking and tired lingo, when what we really need is clear advice and information.

Just think about the most common golf phrase: "par for the course." While that's a clear, concise message to a golfer about how many strokes an individual hole or course should take, in business it's a little murkier. Here, "par for the course" means what's normal or expected. Phrases like this represent the status quo—words without clarity and an absence of new ideas.

Conversely, phrases such as "on the same page" and "game changer" are among the most overused clichés in business—and they have even less application in golf. A caddie who tells a golfer to get "on the same page" with the ball will likely be looking for a new line of work. So too should a consultant who simply tells a client that a new process or piece of software is a "game changer."

Clear, concise information, presented in a way that's easy to understand—and proves that you're being heard—is what you should experience in business and on the course. It's what Grant Thornton envisioned when it launched Status Go, and it's how the professional services firm is delivering the right solutions based on each company's needs and goals. So next time you're on the green and someone tells you to "be the ball" or "optimize your launch angle," don't get frustrated. You'll know there's a better way. ■

HOW RICKIE FOWLER DEFIES STATUS QUO.

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ON TOMORROW

ALWAYS FOLLOWS
THROUGH

FLEXIBLE APPROACH

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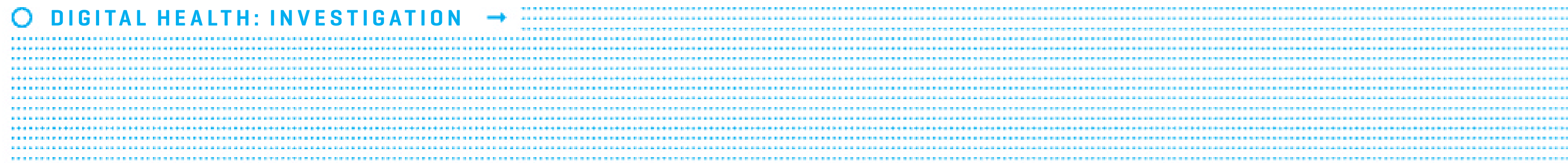


DEATH BY A THOUSAND CLICKS

THE U.S. GOVERNMENT CLAIMED that turning American medical charts into electronic records would make health care better, safer, and cheaper. Ten years and $36 billion later, the system is an unholy mess. Inside a digital revolution gone wrong.

BY ERIKA FRY AND FRED SCHULTE →

PHOTOGRAPH BY **THE VOORHES**

CHARLES OMMANNEY—GETTY IMAGES

THE PAIN RADIATED from the top of Annette Monachelli's head, and it got worse when she changed positions. It didn't feel like her usual migraine. The 47-year-old Vermont attorney turned innkeeper visited her local doctor at the Stowe Family Practice twice about the problem in late November 2012, but got little relief.

Two months later, Monachelli was dead of a brain aneurysm, a condition that, despite the symptoms and the appointments, had never been tested for or diagnosed until she turned up in the emergency room days before her death.

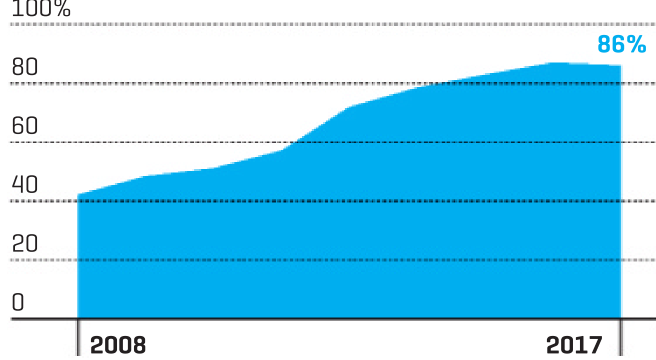
Monachelli's husband sued Stowe, the federally qualified health center the physician worked for. Owen Foster, a newly hired assistant U.S. attorney with the District of Vermont, was assigned to defend the government. Though it looked to be a standard medical malpractice case, Foster was on the cusp of discovering something much bigger—what his boss, U.S. Attorney Christina Nolan, calls the "frontier of health care fraud"—and prosecuting a first-of-its-kind case that landed the largest-ever financial recovery in Vermont's history.

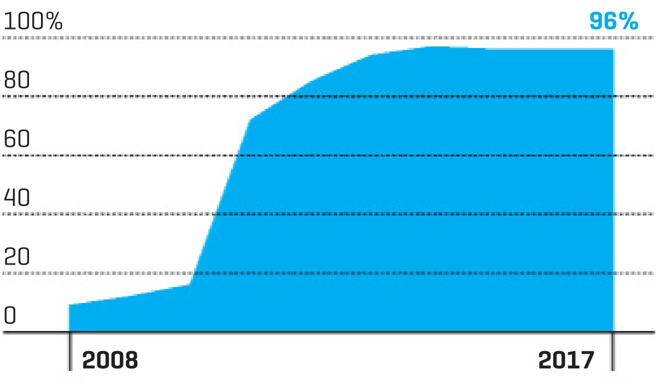
Foster began with Monachelli's medical records, which offered a puzzle. Her doctor had considered the possibility of an aneurysm and, to rule it out, had ordered a head scan through the clinic's software system, the government alleged in court filings. The test, in theory, would have caught the bleeding in Monachelli's brain. But the order never made it to the lab; it had never been transmitted.

The software in question was an electronic health records system, or EHR, made by eClinicalWorks (eCW), one of the leading sellers of record-keeping software for physicians in America, currently used by 850,000 health professionals in the U.S. It didn't take long for Foster to assemble a dossier of troubling reports—Better Business Bureau complaints, issues flagged on an eCW user board, and legal cases filed around the country—suggesting the company's technology didn't work quite like it said it did.

CHARTING A NEW PATH

The stimulus bill accomplished one of its goals in dramatic fashion: driving the rapid adoption of EHRs at physician practices and hospitals.





SOURCE: U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

Above left, Joe Biden watches Barack Obama sign the American Recovery and Reinvestment Act in February 2009, which included a stimulus for electronic health records; David Blumenthal, Obama's national coordinator for health information technology from 2009 to 2011.

Until this point, Foster, like most Americans, knew next to nothing about electronic medical records, but he was quickly amassing clues that eCW's software had major problems—some of which put patients, like Annette Monachelli, at risk.

Damning evidence came from a whistleblower claim filed in 2011 against the company. Brendan Delaney, a British cop turned EHR expert, was hired in 2010 by New York City to work on the eCW implementation at Rikers Island, a jail complex that then had more than 100,000 inmates. But soon after he was hired, Delaney noticed scores of troubling problems with the system, which became the basis for his lawsuit. The patient medication lists weren't reliable; prescribed drugs would not show up, while discontinued drugs would appear as current, according to the complaint. The EHR would sometimes display one patient's medication profile accompanied by the physician's note for a different patient, making it easy to misdiagnose or prescribe a drug to the wrong individual. Prescriptions, some 30,000 of them in 2010, lacked proper start and stop dates, introducing the opportunity for under- or overmedication. The eCW system did not reliably track lab results, concluded Delaney, who tallied 1,884 tests for which they had never gotten outcomes.

The District of Vermont launched an official federal investigation in 2015.

The eCW spaghetti code was so buggy that when one glitch got fixed, another would develop, the government found. The user interface offered a few ways to order a lab test or

Fortune and Kaiser Health News (KHN) collaborated on this joint investigation for three months. For more on this ongoing probe, including videos and additional reporting, visit fortune.com/longform/medical-records and khn.org/ehr

diagnostic image, for example, but not all of them seemed to function. The software would detect and warn users of dangerous drug interactions, but unbeknownst to physicians, the alerts stopped if the drug order was customized. "It would be like if I was driving with the radio on and the windshield wipers going and when I hit the turn signal, the brakes suddenly didn't work," says Foster.

The eCW system also failed to use the standard drug codes, and in some instances, lab and diagnosis codes as well, the government alleged.

The case never got to a jury. In May 2017, eCW paid a $155 million settlement to the government over alleged "false claims" and kickbacks—one physician made tens of thousands of dollars—to clients who promoted its product. Despite the record settlement, the company denied wrongdoing; eCW did not respond to numerous requests for comment.

If there is a kicker to this tale, it is this: The U.S. government bankrolled the adoption of this software—and continues to pay for it. Or we should say: You do.

Which brings us to the strange, sad, and aggravating story that unfolds below. It is not about one lawsuit or a piece of sloppy technology. Rather, it's about a trouble-prone industry that intersects, in the most personal way, with every one of our lives. It's about a $3.7-trillion-dollar health care system idling at the crossroads of progress. And it's about a slew of unintended consequences—the surprising casualties of a big idea whose time had seemingly come.

THE VIRTUAL MAGIC BULLET

ELECTRONIC HEALTH RECORDS were supposed to do a lot: make medicine safer, bring higher-quality care, empower patients, and yes, even save money. Boosters heralded an age when researchers could harness the big data within to reveal the most effective treatments for disease and sharply reduce medical errors. Patients, in turn, would have truly portable health records, being able to share their medical histories in a flash with doctors and hospitals anywhere in the country—essential when life-and-death decisions are being made in the ER.

But 10 years after President Barack Obama signed a law to accelerate the digitization of medical records—with the federal government, so far, sinking $36 billion into the effort—America has little to show for its investment. Kaiser Health News (KHN) and *Fortune* spoke with more than 100 physicians, patients,

Seema Verma, the administrator of the Centers for Medicare and Medicaid Services, is taking on health "information blockers," gag clauses, and more.

IT experts and administrators, heath policy leaders, attorneys, top government officials, and representatives at more than a half-dozen EHR vendors, including the CEOs of two of the companies. The interviews reveal a tragic missed opportunity: Rather than an electronic ecosystem of information, the nation's thousands of EHRs largely remain a sprawling, disconnected patchwork. Moreover, the effort has handcuffed health providers to technology they mostly can't stand and has enriched and empowered the $13-billion-a-year industry that sells it.

By one measure, certainly, the effort has achieved what it set out to do: Today, 96% of hospitals have adopted EHRs, up from just 9% in 2008. But on most other counts, the newly installed technology has fallen well short. Physicians complain about clumsy, unintuitive systems and the number of hours spent clicking, typing, and trying to navigate them—which is more than the hours they spend with patients. Unlike, say, with the global network of ATMs, the proprietary EHR systems made by more than 700 vendors routinely don't talk to one another, meaning that doctors still resort to transferring medical data via fax and CD-ROM. Patients, meanwhile, still struggle to access their own records—and, sometimes, just plain can't.

Instead of reducing costs, many say EHRs, which were originally optimized for billing rather than for patient care, have instead made it easier to engage in "upcoding" or bill inflation (though some say the systems also make such fraud easier to catch).

More gravely still, a months-long joint investigation by KHN and *Fortune* has found that instead of streamlining medicine, the government's EHR initiative has created a host of largely unacknowledged patient safety risks. Our investigation found that alarming reports of patient deaths, serious injuries, and near misses—thousands of them—tied to software glitches, user errors, or other flaws have piled up, largely unseen, in various government-funded and private repositories.

Compounding the problem are entrenched secrecy policies that continue to keep software failures out of public view. EHR vendors often impose contractual "gag clauses" that discourage buyers from speaking out about safety issues and disastrous software installations—though some customers have taken to the courts to air their grievances. Plaintiffs, moreover, say hospitals often fight to withhold records from injured patients or their families. Indeed, two doctors who spoke candidly about the problems they faced with EHRs later asked that their names not be used, adding that they were forbidden by their health care organizations to talk. Says Assistant U.S. Attorney Foster, the EHR vendors "are protected by a shield of silence."

Though the software has reduced some types of clinical mistakes common in the era of handwritten notes, Raj Ratwani, a researcher at MedStar Health in Washington, D.C., has documented new patterns of medical errors tied to EHRs that he believes are both perilous and preventable. "The fact that we're not able to broadcast that nationally and solve these issues immediately, and that another patient somewhere else may be harmed by the very same issue—that just can't happen," he says.

David Blumenthal, who, as Obama's national coordinator for health information technology, was one of the architects of the EHR initiative, acknowledges to KHN and *Fortune* that electronic health records "have not fulfilled their potential. I think few would argue they have."

The former President has likewise singled out the effort as one of his most disappointing, bemoaning in a January 2017 interview with Vox "the fact that there are still just mountains of paperwork ... and the doctors still have to input stuff, and the nurses are spending all their time on all this administrative work. We put a big slug of money into trying to encourage everyone to digitalize, to catch up with the rest of the world ... that's been harder than we expected."

Seema Verma, the current chief of the Centers for Medicare and Medicaid Services (CMS), which oversees the EHR effort today, shudders at the billions of dollars spent building software that doesn't share data—an electronic bridge to nowhere. "Providers developed their own systems that may or may not even have worked well for them," she tells KHN and *Fortune* in an interview this February, "but we didn't think about how all these systems connect with one another. That was the real missing piece."

Perhaps none of the initiative's former boosters is quite as frustrated as former Vice President Joe Biden. At a 2017 meeting with health care leaders in Washington, he railed against the infuriating challenge of getting his son Beau's medical records from one hospital to another. "I was stunned when my son for a year was battling Stage 4 glioblastoma," said Biden. "I couldn't get his records. I'm the Vice President of the United States of America ... It was an absolute nightmare. It was ridiculous, absolutely ridiculous, that we're in that circumstance."

A BRIDGE TO NOWHERE

AS BIDEN WILL TELL YOU, the original concept was a smart one. The wave of digitization had swept up virtually every industry, bringing both disruption and, in most cases, greater efficiency. And perhaps none of these industries was more deserving of digital liberation than medicine, where life-measuring and potentially lifesaving data was locked away in paper crypts—stack upon stack of file folders at doctors' offices across the country.

Stowed in steel cabinets, the records were next to useless. Nobody—particularly at the dawn of the age of the iPhone—thought it was a good idea to leave them that way. The problem, say critics, was in the way that policy-

▲ PHOTOGRAPH BY **T.J. KIRKPATRICK**

makers set about to transform them.

"Every single idea was well-meaning and potentially of societal benefit, but the combined burden of all of them hitting clinicians simultaneously made office practice basically impossible," says John Halamka, chief information officer at Beth Israel Deaconess Medical Center, who served on the EHR standards committees under both George W. Bush and Barack Obama. "In America, we have 11 minutes to see a patient, and, you know, you're going to be empathetic, make eye contact, enter about 100 pieces of data, and never commit malpractice. It's not possible!"

KHN and *Fortune* examined more than two dozen medical negligence cases that have alleged that EHRs either contributed to injuries, had been improperly altered, or were withheld from patients to conceal substandard care. In such cases, the suits typically settle prior to trial with strict confidentiality pledges, so it's often not possible to determine the merits of the allegations. EHR vendors also frequently have contract stipulations, known as "hold harmless clauses," that protect them from liability if hospitals are later sued for medical errors—even if they relate to an issue with the technology.

But lawsuits, like that filed by Fabian Ronisky, which do emerge from this veil, are quite telling.

Ronisky, according to his complaint, arrived by ambulance at Providence Saint John's Health Center in Santa Monica on the afternoon of March 2, 2015. For two days, the young lawyer had been suffering from severe headaches while a disorienting fever left him struggling to tell the 911 operator his address.

Suspecting meningitis, a doctor at the hospital performed a spinal tap, and the next day an infectious disease specialist typed in an order for a critical lab test—a check of the spinal fluid for viruses, including herpes simplex—into the hospital's EHR.

The multimillion-dollar system, manufactured by Epic Systems Corp. and considered by some to be the Cadillac of medical software, had been installed at the hospital about four months earlier. Although the order appeared on Epic's screen, it was not sent to the lab. It turned out, Epic's software didn't fully "interface" with the lab's software, according to a lawsuit Ronisky filed in February 2017 in Los Angeles County Superior Court. His results and diagnosis were delayed—by days, he claims—during which time he suffered irreversible brain damage from herpes encephalitis. The suit alleged the mishap delayed doctors from giving Ronisky a drug called acyclovir that may have minimized damage to his brain.

Epic denied any liability or defects in its software; the company said the doctor failed to push the right button to send the order and that the hospital, not Epic, had configured the interface with the lab. Epic, among the nation's largest manufacturers of computerized health records and the leading provider to most of America's most elite medical centers, quietly paid $1 million to settle the suit in July 2018, according to court records. The hospital and two doctors paid a total of $7.5 million, and a case against a third doctor is pending trial. Ronisky, 34, who is fighting to rebuild his life, declined to comment.

Incidents like that which happened to Ronisky—or to Annette Monachelli, for that matter—are surprisingly common, data shows. And the back-and-forth about where the fault lies in such cases is actually part of the problem: The systems are often so confusing (and training on them seldom sufficient) that errors frequently fall into a nether zone of responsibility. It can be hard

4,000

Approximate number of computer clicks an ER doctor makes over the course of a single shift, according to an *American Journal of Emergency Medicine* study

GLOSSARY

ALERT FATIGUE
The phenomenon in which health care workers, exposed to so many alarms, miss the occasional meaningful ones. EHR alerts are well-intentioned safeguards for workers, but many users complain there are too many irrelevant ones.

NOTE BLOAT
The voluminous form doctors' notes take in the EHR. (Epic says they've doubled in length over the past decade.) Many blame the swelling records on extensive documentation requirements and physicians' tendency to cut-and-paste notes from previous encounters.

PAJAMA TIME
The hours physicians log after work to complete the documentation and other administrative tasks they have to perform on their electronic health record systems. According to the *Annals of Family Medicine*, it amounts to an extra 90 minutes of work per day.

INFO BLOCKING
The act of keeping health information from entitled parties, including patients and the health providers they want to share it with. Health systems hold that data dear and often behave as if that electronic information is harder to share than it is.

to tell where human error begins and the technological shortcomings end.

EHRs promised to put all of a patient's records in one place, but often that's the problem. Critical or time-sensitive information routinely gets buried in an endless scroll of data, where in the rush of medical decision-making—and amid the maze of pulldown menus—it can be missed.

Thirteen-year-old Brooke Dilliplaine, who was severely allergic to dairy, was given a probiotic containing milk. The two doses sent her into "complete respiratory distress" and resulted in a collapsed lung, according to a lawsuit filed by her mother. Rory Staunton, age 12, scraped his arm in gym class and then died of sepsis after ER doctors discharged the boy on the basis of lab results in the EHR that weren't complete. And then there's the case of Thomas Eric Duncan. The 42-year-old man was sent home in 2014 from a Dallas hospital infected with Ebola virus. Though a nurse had entered in the EHR his recent travel to Liberia, where an Ebola epidemic was then in full swing, the doctor never saw it. Duncan died a week later.

Many such cases end up in court. Typically, doctors and nurses blame faulty technology in the medical-records systems. The EHR vendors blame human error. And meanwhile, the cases mount.

Quantros, a private health-care analytics firm, said it has logged 18,000 EHR-related safety events from 2007 through 2018, 3% of which resulted in patient harm, including seven deaths—a figure that a Quantros director says is "drastically underreported."

A 2016 study by The Leapfrog Group, a patient-safety watchdog based in Washington, D.C., found that the medication-ordering function of hospital EHRs—a feature required by the government for certification but often configured differently in each system—failed to flag potentially harmful drug orders in 39% of cases in a test simulation. In 13% of those cases, the mistake could have been fatal.

The Pew Charitable Trusts has, for the past few years, run an EHR safety project, taking aim at issues like usability and patient matching—the process of linking the correct medical record to the correct patient—a seemingly basic task at which the systems, even when made by the same EHR vendor, often fail. At some institutions, according to Pew, such matching was accurate only 50% of the time. Patients have discovered mistakes as well: A January survey by the Kaiser Family Foundation found that one in five patients spotted an error in their electronic medical records.

The Joint Commission, which certifies hospitals, has sounded alarms about a number of issues, including false alarms—which account for between 85% and 99% of EHR and medical device alerts. (One study by researchers at Oregon Health & Science University estimated that the average clinician working in the intensive care unit may be exposed to up to 7,000 passive alerts per day.) Such over-warning can be dangerous. Between 2014 and 2018, the commission tallied 170 mostly voluntary reports of patient harm related to alarm management and alert fatigue—the phenomenon in which health workers, so overloaded with unnecessary warnings, ignore the occasional meaningful one. Of those 170 incidents, 101 resulted in patient deaths.

The Pennsylvania Patient Safety Authority, an independent state agency that collects information about adverse events and incidents, counted 775 "laboratory-test problems" related to health IT between January 2016 and December 2017.

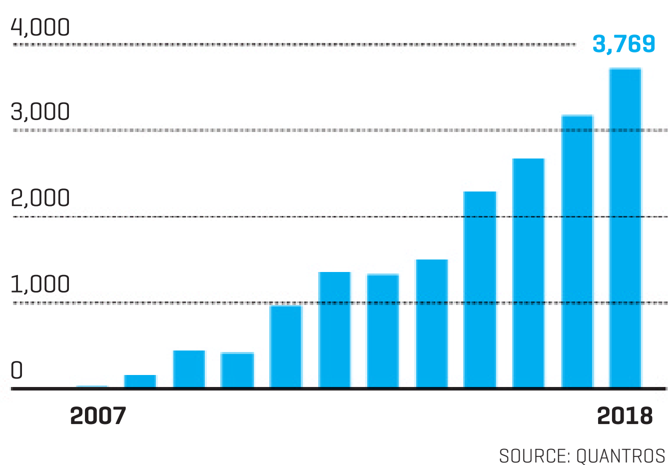
To be sure, medical errors happened en masse in the age of paper medicine, when hospital staffers misinterpreted a physician's scrawl or read the wrong chart to deadly consequence, for instance. But what is perhaps telling is how many doctors today opt for manual workarounds to their EHRs. Aaron Zachary Hettinger, an emergency medicine physician with MedStar Health in Washington, D.C., says that when he and fellow clinicians need to share critical patient information, they write it on a whiteboard or on a paper towel and leave it on their colleagues' computer keyboards.

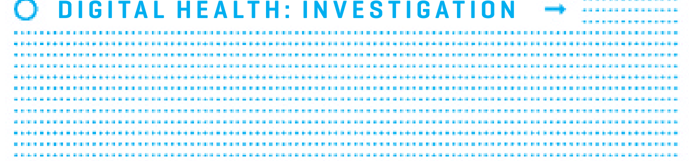
While the FDA doesn't mandate reporting of EHR safety events—as it does for regulated medical devices—concerned posts have nonetheless proliferated in the FDA MAUDE database of adverse events, which now serves as an ad hoc bulletin board of warnings about the various systems.

Further complicating the picture is that health providers nearly always tailor their one-size-fits-all EHR systems to their own specifications. Such customization makes every one unique and often hard to compare

DANGER SIGNS

Safety events owing to EHR and other health IT issues have been steadily rising. Even so, experts say cases are widely underreported.





with others—which, in turn, makes the source of mistakes difficult to determine.

Martin Makary, a surgical oncologist at Johns Hopkins and the coauthor of a much-cited 2016 study that identified medical errors as the third leading cause of death in America, credits EHRs for some safety improvements—including recent changes that have helped put electronic brakes on the opioid epidemic. But, he says, "we've swapped one set of problems for another. We used to struggle with handwriting and missing information. We now struggle with a lack of visual cues to know we're writing and ordering on the correct patient."

Joseph Schneider, a pediatrician at UT Southwestern Medical Center, compares the transition we've made, from paper records to electronic ones, to moving from horses to automobiles. But in this analogy, he adds, "Our cars have advanced to about the 1960s. They still don't have seat belts or airbags."

Schneider recalls one episode when his colleagues couldn't understand why chunks of their notes would inexplicably disappear. They figured out the problem weeks later after intense study: Physicians had been inputting squiggly brackets—{}—the use of which, unbeknownst to even vendor representatives, deleted the text between them. (The EHR maker initially blamed the doctors, says Schneider.)

A broad coalition of actors, from National Nurses United to the Texas Medical Association to leaders within the FDA, has long called for oversight on electronic-record safety issues. Among the most outspoken is Ratwani, who directs MedStar Health's National Center on Human Factors in Healthcare, a 30-person institute focused on optimizing the safety and usability of medical technology. Ratwani spent his early career in the defense industry,

5.9 HOURS

Average time (out of an 11.4-hour workday) doctors spend on EHRs, compared with 5.1 hours spent with patients, according to a 2017 study in the *Annals of Family Medicine*

Bobby and Tara Dilliplaine hold a photo of their late daughter Brooke, who suffered complications when she was given medication she was allergic to. (She later died of causes unrelated to the EHR issue.)

studying things like the intuitiveness of information displays. When he got to MedStar in 2012, he was stunned by "the types of [digital] interfaces being used" in health care, he says.

In a study published last year in the journal *Health Affairs*, Ratwani and colleagues studied medication errors at three pediatric hospitals from 2012 to 2017. They discovered that 3,243 of them were owing in part to EHR "usability issues." Roughly one in five of these could have resulted in patient harm, the researchers found. "Poor interface design and poor implementations can lead to errors and sometimes death, and that is just unbelievably bad as well as completely fixable," he says. "We should not have patients harmed this way."

Using eye-tracking technology, Ratwani has demonstrated on video just how easy it is to make mistakes when performing basic tasks on the nation's two leading EHR systems. When emergency room doctors went to order Tylenol, for example, they saw a drop-down menu listing 86 options, many of which were irrelevant for the specified patient. They had to read the list carefully, so as not to click the wrong dosage or form—though many do that too: In roughly one out of 1,000 orders, physicians accidentally select the suppository (designated "PR") rather than the tablet dose ("OR"), according to one estimate. That's not an error that will harm a patient—though other medication mix-ups can and do.

Earlier this year, MedStar's human-factors center launched a website and public awareness campaign with the American Medical Association to draw attention to such rampant mistakes—they use the letters "EHR" as an initialism for "Errors Happen Regularly"—and to petition Congress for action. Ratwani is pushing for a central database to track such errors and adverse events.

Others have turned to social media to vent. Mark Friedberg, a health-policy researcher with the RAND Corporation who is also a practicing primary care physician, champions the Twitter hashtag #EHRbuglist to encourage fellow health care workers to air their pain points. And last month, a scathing Epic parody account cropped up on Twitter, earning more than 8,000 followers in its first five days. Its maiden tweet, written in the mock voice of an Epic overlord, read: "I once saw a doctor make eye contact with a patient. This horror must stop."

▲ PHOTOGRAPH BY HEIDI DE MARCO—KHN

As much as EHR systems are blamed for sins of commission, it is often the sins of omission that trip up users even more.

Consider the case of Lynne Chauvin, who worked as a medical assistant at Ochsner Health System, in Louisiana. In a still-pending 2015 lawsuit, Chauvin alleges that Epic's software failed to fire a critical medication warning; Chauvin suffered from conditions that heightened her risk for blood clots, and though that history was documented in her records, she was treated with drugs that restricted blood flow after a heart procedure at the hospital. She developed gangrene, which led to the amputation of her lower legs and forearm. (Ochsner Health System said that while it cannot comment on ongoing litigation, it "remains committed to patient safety which we strongly believe is optimized through the use of electronic health record technology." Epic declined to comment.)

Echoing the complaints of many doctors, the suit argues that Epic software "is extremely complicated to view and understand," owing to "significant repetition of data." Chauvin says that her medical bills have topped $1 million and that she is permanently disabled. Her husband, Richard, has become her primary caregiver and had to retire early from his job with the city of Kenner to care for his wife, according to the suit. Each party declined to comment.

AN EPIDEMIC OF BURNOUT

THE NUMBING REPETITION, the box-ticking, and the endless searching on pulldown menus are all part of what Ratwani calls the "cognitive burden" that's wearing out today's physicians and driving increasing numbers into early retirement.

In recent years, "physician burnout" has skyrocketed to the top of the agenda in medicine. A 2018 Merritt Hawkins survey found a staggering 78% of doctors suffered symptoms of burnout, and in January the Harvard School of Public Health and other institutions deemed it a "public health crisis."

One of the coauthors of the Harvard study, Ashish Jha, pinned much of the blame on "the growth in poorly designed digital health records ... that [have] required that physicians spend more and more time on tasks that don't directly benefit patients."

Few would deny that the swift digitization of America's medical system has been transformative. With EHRs now nearly universal, the face and feel of medicine has changed. The doctor is now typing away, making more eye contact with the computer screen, perhaps, than with the patient. Patients don't like that dynamic; for doctors, whose days increasingly begin and end with such fleeting encounters, the effect can be downright deadening.

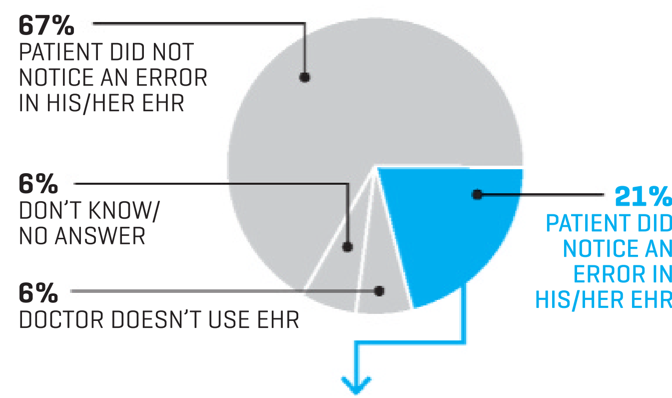
"You're sitting in front of a patient, and there are so many things you have to do, and you only have so much time to do it in—seven to 11 minutes, probably—so when do you really listen?" asks John-Henry Pfifferling, a medical anthropologist who counsels physicians suffering from burnout. "If you go into medicine because you care about interacting, and then you're just a tool, it's dehumanizing," says Pfifferling, who has seen many physicians leave medicine over the shift to electronic records. "It's a disaster," he says.

Beyond complicating the physician-patient relationship,

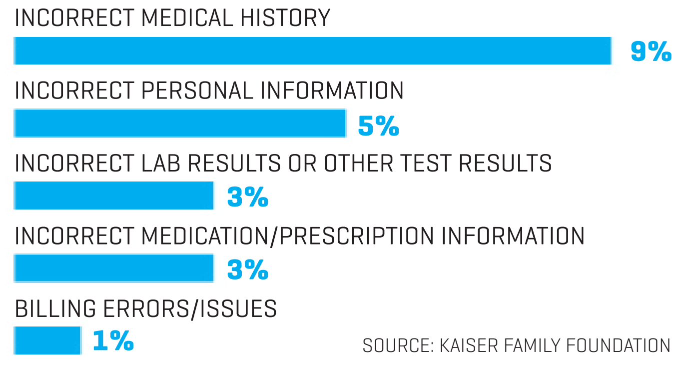
BROKEN RECORDS

One in five people surveyed this year by the Kaiser Family Foundation has found a mistake in their EHR. Of those, nearly half have incorrect medical histories.

RELIABILITY OF EHR



TYPE OF ERROR NOTICED IN THE MEDICAL RECORD



SOURCE: KAISER FAMILY FOUNDATION

EHRs have in some ways made practicing medicine harder, says Hal Baker, a physician and the chief information officer at WellSpan, a Pennsylvania hospital system. "Physicians have to cognitively switch between focusing on the record and focusing on the patient," he says. He points out how unusual—and potentially dangerous—this is: "Texting while you're driving is not a good idea. And I have yet to see the CEO who, while running a board meeting, takes minutes, and certainly I've never heard of a judge who, during the trial, would also be the court stenographer. But in medicine ... we've asked the physician to move from writing in pen to [entering a computer] record, and it's a pretty complicated interface."

Even if docs may be at the keyboard during visits, they report having to spend hours more outside that time—at lunch, late at night—in order to finish notes and keep up

with electronic paperwork (sending referrals, corresponding with patients, resolving coding issues). That's right. EHRs didn't take away paperwork; the systems just moved it online. And there's a lot of it: 44% of the roughly six hours a physician spends on the EHR each day is focused on clerical and administrative tasks, like billing and coding, according to a 2017 *Annals of Family Medicine* study.

For all that so-called pajama time—the average physician logs 1.4 hours per day on the EHR after work—they don't get a cent.

Many doctors do recognize the value in the technology: 60% of participants in Stanford Medicine's 2018 National Physician Poll said EHRs had led to improved patient care. At the same time, about as many (59%) said EHRs needed a "complete overhaul" and that the systems had detracted from their professional satisfaction (54%) as well as from their clinical effectiveness (49%).

In preliminary studies, Ratwani has found that doctors have a typical physiological reaction to using an EHR: stress. When he and his team shadow clinicians on the job, they use a range of sensors to monitor the doctors' heart rate and other vital signs over the course of their shift. The physicians' heart rates will spike—as high as 160 beats per minute—on two sorts of occasions: when they are interacting with patients and when they're using the EHR.

"Everything is so cumbersome," says Karla Dick, a family medicine doctor in Arlington, Texas. "It's slow compared to a paper chart. You're having to click and zoom in and zoom out to look for stuff." With all the zooming in and out, she explains it's easy to end up in the wrong record. "I can't tell you how many times I've had to cancel an order because I was in the wrong chart."

Among the daily frustrations for one emergency room physician in Rhode Island is ordering ibuprofen, a seemingly simple task that now requires many rounds of mouse clicking. Every time she prescribes the basic painkiller for a female patient, whether that patient is 9 or 68 years old, the prescription is blocked by a pop-up alert warning her that it may be dangerous to give the drug to a pregnant woman. The physician, whose institution does not allow her to comment on the systems, must then override the warning with yet more clicks. "That's just the tiniest tip of the iceberg," she says.

What worries the doctor most is the ease with which diligent, well-meaning physicians can make serious medical errors. She notes that the average ER doc will make 4,000 mouse clicks over the course of a shift, and that the odds of doing anything 4,000 times without an error is small. "The interfaces are just so confusing and clunky," she adds. "They invite error ... it's not a negligence issue. This is a poor tool issue."

Many of the EHR makers acknowledge physician burnout is real and say they're doing what they can to lessen the burden and enhance user experience. Sam Butler, a pulmonary critical care specialist who started working at Epic in 2001, leads those efforts at the Wisconsin-based company. When doctors get more than 100 messages per week in their in-basket (akin to an email inbox), there's a higher likelihood of burnout. Butler's team has also analyzed doctors' electronic notes—they're twice as long as they were nine years ago, and three to four times as long as notes in the rest of the world. He says Epic uses such insights to improve the client experience. But coming up with fixes is difficult because doctors "have different viewpoints on everything," he says. (KHN and *Fortune* made multiple requests to interview Epic CEO Judith Faulkner, but the company declined to make her available. In a trade interview in February, however, Faulkner said that EHRs were unfairly blamed for physician burnout and cited a study suggesting that there's little correlation between burnout and EHR satisfaction. Executives at other vendors noted that they're aware of usability issues and that they're working on addressing them.)

"It's not that we're a bunch of Luddites who don't know how to use technology," says the Rhode Island ER doctor. "I have an iPhone and a computer and they work the way they're supposed to work, and then we're given these incredibly cumbersome and error-prone tools. This is something the government mandated. There really wasn't the time to let the cream rise to the top; everyone had to jump in and pick something that worked and spend tens of millions of dollars on a system that is slowly killing us."

$36 BILLION AND CHANGE

THE EFFORT TO DIGITIZE America's health records got its biggest push in a very low moment: the financial crisis of 2008. In early December of that year, Obama, barely four weeks after his election, pitched an ambitious economic recovery plan. "We will make sure that every doctor's office and hospital in this country is using cutting-edge technology and electronic medical records

BRAINSTORM HEALTH CONFERENCE

Fortune's fourth annual Brainstorm Health event will be held April 2–3 in San Diego. For more information—as well as access to stories and live video—go to fortune.com

MedStar's Raj Ratwani (standing) studies eye-tracking with Dr. Zach Hettinger to see how doctors interact with EHRs.

so that we can cut red tape, prevent medical mistakes, and help save billions of dollars each year," he said in a radio address. The idea had already been a fashionable one in Washington. Former House Speaker Newt Gingrich was fond of saying it was easier to track a FedEx package than one's medical records. Obama's predecessor, President George W. Bush, had also pursued the idea of wiring up the country's health system. He didn't commit much money, but Bush did create an agency to do the job: the Office of the National Coordinator (ONC).

In the depths of recession, the EHR conceit looked like a shovel-ready project that only the paper lobby could hate. In February 2009 legislators passed the HITECH Act, which carved out a hefty chunk of the massive stimulus package for health information technology. The goal was not just to get hospitals and doctors to buy EHRs, but rather to get them using them in a way that would drive better care. So lawmakers devised a carrot-and-stick approach: Physicians would qualify for federal subsidies (a sum of up to nearly $64,000 over a period of years) only if they were "meaningful users" of a government-certified system. Vendors, for their part, had to develop systems that met the government's requirements.

They didn't have much time, though. The need to stimulate the economy, which meant getting providers to adopt EHRs quickly, "presented a tremendous conundrum," says Farzad Mostashari, who joined the ONC as deputy director in 2009 and became its leader in 2011: The ideal—creating a useful, interoperable, nationwide records system—was "utterly infeasible to get to in a short time frame."

That didn't stop the federal planners from pursuing their grand ambitions. Everyone had big ideas for the EHRs. The FDA wanted the systems to track unique device identifiers for medical implants, the CDC wanted them to support disease surveillance, CMS wanted them to include quality metrics, and so on. "We had all the right ideas that were discussed and hashed out by the committee," says Mostashari, "but they were *all* of the right ideas."

Not everyone agreed, though, that they were the right ideas. Before long, "meaningful use" became pejorative shorthand to many for a burdensome government program—making doctors do things like check a box indicating a patient's smoking status each and every visit.

The EHR vendor community, then a scrappy $2 billion industry, griped at the litany of requirements but stood to gain so much from the government's $36 billion injection that it jumped in line. As Rusty Frantz, CEO of EHR vendor NextGen Healthcare, put it: "The

PHOTOGRAPH BY T.J. KIRKPATRICK

industry was like, 'I've got this check dangling in front of me, and I have to check these boxes to get there, and so I'm going to do that.'"

Halamka, who was an enthusiastic backer of the initiative in both the Bush and Obama administrations, blames the pressure for a speedy launch as much as the excessive wish list. "To go from a regulation to a highly usable product that is in the hands of doctors in 18 months, that's too fast," he says. "It's like asking nine women to have a baby in a month."

Several of those who worked on the project admit the rollout was not as easy or seamless as they'd anticipated, but they contend that was never the point. Aneesh Chopra, appointed by Obama in 2009 as the nation's first chief technology officer, called the spending a "down payment" on a vision to fundamentally change American medicine—creating a digital infrastructure to support new ways to pay for health services based on their quality and outcomes.

Bob Kocher, a physician and star investor with venture capital firm Venrock, who served in the Obama administration from 2009 to 2011 as a health and economic policy adviser, not only defends the rollout then but also disputes the notion that the government initiative has been a failure at all. "EHRs have totally lived up to the hype and expectations," he says, emphasizing that they also serve as a technology foundation to support innovation on everything from patients accessing their medical records on a smartphone to A.I.-driven medical sleuthing. Others note the systems' value in aggregating medical data in ways that were never possible with paper—helping, for example, to figure out that contaminated water was poisoning children in Flint, Mich.

But Rusty Frantz heard a far different message about EHRs—and, more important, it was coming from his own customers.

The Stanford-trained engineer, who in 2015 became CEO of NextGen, a $500-million-a-year EHR heavyweight in the physician-office market, learned the hard way about how his product was being viewed. As he stood at the podium at his first meeting with thousands of NextGen customers at Las Vegas's Mandalay Bay Resort, just four months after getting the job, he tells KHN and *Fortune*, "People were lining up at the microphones to yell at us: 'We weren't delivering stable software! The executive team was inaccessible! The service experience was terrible!'" (He now refers to the event as "Festivus: the airing of the grievances.")

Frantz had bounced around the health care industry for much of his career, and from the nearby perch of a medical device company, he watched the EHR incentive bonanza with a mix of envy and slack-jawed awe. "The industry was moving along in a natural Darwinist way, and then along came the stimulus," says Frantz, who blames the government's ham-handed approach to regulation. "The software got slammed in, and the software wasn't implemented in a way that supported care," he says. "It was installed in a way that supported stimulus. This company, we were complicit in it too."

Even that may be a generous description. KHN and *Fortune* found a trail of lawsuits against the company, stretching from White Sulphur Springs, Mont., to Neillsville, Wis. Mary Rutan Hospital in Bellefontaine, Ohio, sued NextGen (formerly called Quality Systems) in federal court in 2013, arguing that it experienced hundreds of problems with the "materially defective" software the company had installed in 2011.

A consultant hired by the hospital to evaluate the NextGen system, whose 60-page report was submitted to the court, identified "many functional defects" that he said rendered the software "unfit for its intended purpose." Some patient information was not accurately recorded, which had the potential, the consultant wrote, "to create major patient care risk which could lead to, at a minimum, inconvenience, and at worst, malpractice or even death." Glitches at Mary Rutan included incidents in which the software would apparently change a patient's gender at random or lose a doctor's observations after an exam, the consultant reported. The company, he found, sometimes took months to address issues: One IT ticket, which related to a physician's notes inexplicably deleting themselves, reportedly took 10 months to resolve. (The consultant also noted that similar problems appeared to be occurring at as many as a dozen other hospitals that had installed NextGen software.)

The Ohio hospital, which paid more than $1.5 million for its EHR system, claimed breach of contract. NextGen responds that it disputed the claims made in the lawsuit and that the matter was resolved in 2015 "with no findings of fact by a court related to the allegations." The hospital declined to comment.

At the time, as it has been since then, NextGen's software was certified by the government as meeting the requirements of the stimulus program. By 2016, NextGen had more than 19,000 customers who had received federal subsidies.

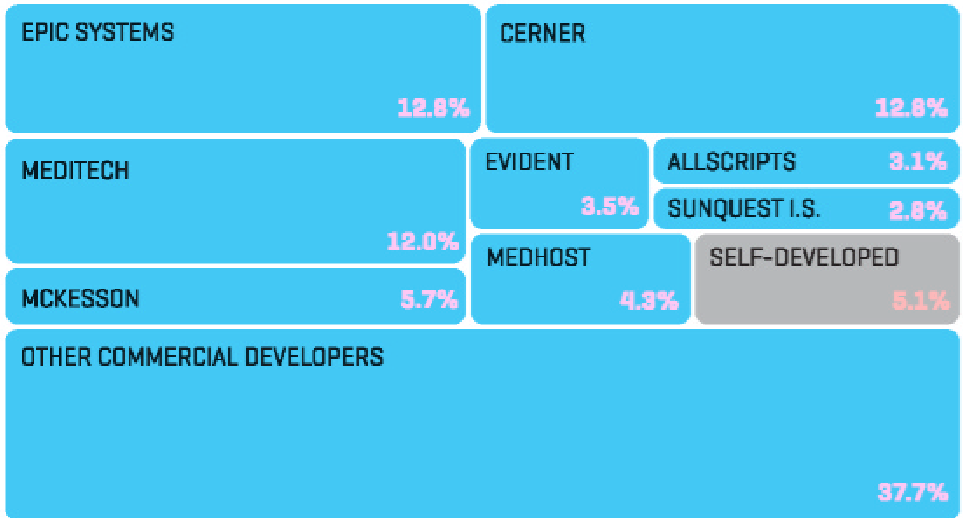
NextGen was subpoenaed by the Department of Justice in December 2017, months after becoming the subject of a federal investigation led by the District of Vermont. Frantz tells KHN and *Fortune* that NextGen is cooperating with the investigation. "This company was not dishonest, but it was not effective four years ago," he says. Frantz also emphasizes that NextGen has "rapidly evolved" during his tenure, earning five industry awards since 2017, and that customers have "responded very positively."

Glen Tullman, who until 2012 led Allscripts, another leading EHR vendor that benefited royally from the stimulus and that has been sued by numerous unhappy customers, admits that the industry's race to market took priority over all else.

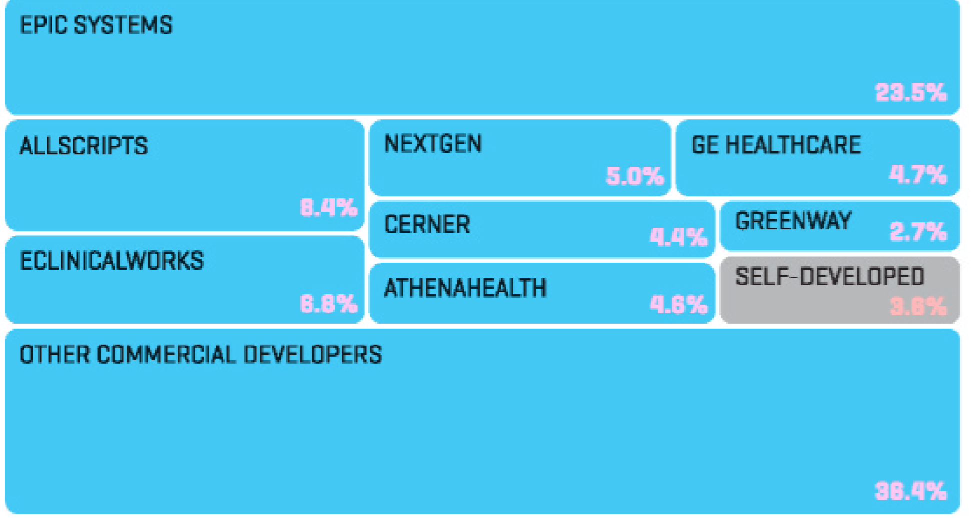
LEADERS OF THE PACK

Although there are more than 700 federally certified EHR vendors in the U.S., most of the business is concentrated among a handful of top sellers. Below, the market-share leaders among hospitals and doctors' offices participating in the Medicare incentive program.

EHR DEVELOPERS FOR HOSPITALS



EHR DEVELOPERS FOR PRIMARY CARE PHYSICIANS, SPECIALISTS, PODIATRISTS, OPTOMETRISTS, DENTISTS, AND CHIROPRACTORS



SOURCE: U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

"It was a big distraction. That was an unintended consequence of that," Tullman says. "All the companies were saying, This is a one-time opportunity to expand our share, focus everything there, and then we'll go back and fix it." The Justice Department has opened a civil investigation into the company, Securities and Exchange Commission filings show. Allscripts says in an email that it cannot comment on an ongoing investigation, but that the civil investigations by the Department of Justice relate to businesses it acquired after the investigations were opened.

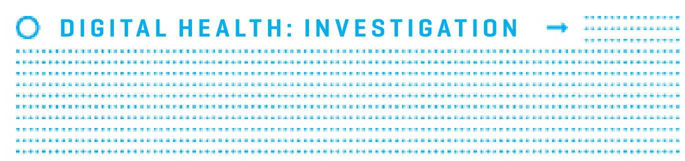
Much of the marketing mayhem occurred because federal officials imposed few controls over firms scrambling to cash in on the stimulus. It was a gold rush—and any system, it seemed, could be marketed as "federally approved." Doctors could shop for bargain-price software packages at Costco and Walmart's Sam's Club—where eClinicalWorks sold a "turnkey" system for $11,925—and cash in on the government's adoption incentives.

The top-shelf vendors in 2009 crisscrossed the country on a "stimulus tour" like rock groups, gigging at some 30 cities, where they offered doctors who showed up to hear the pitch "a customized analysis" of how much money they could earn off the government incentives. Following the same playbook used by pharmaceutical companies, EHR sellers courted doctors at fancy dinners in ritzy hotels. One enterprising software firm advertised a "cash for clunkers" deal that paid $3,000 to doctors willing to trade in their current records system for a new one. Athenahealth held "invitation only" dinners at luxury hotels to advise doctors, among other things, how to use the stimulus to get paid more and capture available incentives. Allscripts offered a no-money-down purchase plan to help doctors "maximize the return on your EHR investment." (An Athenahealth spokesperson says the company's "dinners were educational in nature and aimed at helping physicians navigate the government program." Allscripts did not respond directly to questions about its marketing practices, but says it "is proud of the software and services [it provides] to hundreds of thousands of caregivers across the globe.")

EHRs were supposed to reduce health care costs, at least in part by preventing duplicative tests. But as the federal government opened the stimulus tap, many raised doubts about the promised savings. Advocates bandied about a figure of $80 billion in cost savings even as congressional auditors were debunking it. While the jury's still out, there's growing suspicion the digital revolution may potentially raise health care costs by encouraging overbilling and new strains of fraud and abuse.

In September 2012, following press reports suggesting that some doctors and hospitals were using the new technology to improperly boost their fees, a practice known as "upcoding," then–Health and Human Services chief Kathleen Sebelius and Attorney General Eric Holder warned the industry not to try to "game the system."

There's also growing evidence that some doctors and health systems may have overstated their use of the new technology to secure stimulus funds, a potentially enormous fraud against Medicare and Medicaid that likely will take many years to unravel. In June 2017, the HHS inspector general estimated that Medi-



care officials made more than $729 million in subsidy payments to hospitals and doctors that didn't deserve them.

Individual states, which administer the Medicaid portion of the program, haven't fared much better. Audits have uncovered overpayments in 14 of 17 state programs reviewed, totaling more than $66 million, according to inspector general reports.

Last month Sen. Charles Grassley, an Iowa Republican who chairs the Senate Finance Committee, sharply criticized CMS for recovering only a tiny fraction of these bogus payments, or what he termed a "spit in the ocean."

EHR vendors have also been accused of egregious and patient-endangering acts of fraud as they raced to cash in on the stimulus money grab. In addition to the U.S. government's $155 million False Claims Act settlement with eClinicalWorks noted above, the federal government has reached a second settlement over similar charges against another large vendor, Tampa-based Greenway Health. In February, that company settled with the government for just over $57 million without denying or admitting wrongdoing. "These are cases of corporate greed, companies that prioritized profits over everything else," says Christina Nolan, the U.S. attorney for the District of Vermont, whose office led the cases. (In a response, Greenway Health did not address the charges or the settlement but said it was "committing itself to being the standard-bearer for quality, compliance, and transparency.")

TOWER OF BABEL

IN EARLY 2017, Seema Verma, then the country's newly appointed CMS administrator, went on a listening tour. She visited doctors around the country, at big urban practices and tiny rural clinics, and from those frontline physicians she consistently heard one thing: They hated their electronic health records. "Physician burnout is real," she tells KHN and *Fortune*. The doctors spoke of the difficulty in getting information from other systems and providers, and they complained about the government's reporting requirements, which they perceived as burdensome and not meaningful.

What she heard then became suddenly personal one summer day in 2017, when her husband, himself a physician, collapsed in the airport on his way home to Indianapolis after a family vacation. For a frantic few hours, the CMS administrator fielded phone calls from first responders and physicians—Did she know his medical history? Did she have information that could save his life?—and made calls to his doctors in Indiana, scrambling to piece together his record, which should have been there in one piece. Her husband survived the episode, but it laid bare the dysfunction and danger inherent in the existing health information ecosystem.

The notion that one EHR should talk to another was a key part of the original vision for the HITECH Act, with the government calling for systems to be eventually interoperable.

What the framers of that vision didn't count on were the business incentives working against it. A free exchange of information means that patients can be treated anywhere. And though they may not admit it, many health providers are loath to lose their patients to a competing doctor's office or hospital. There's a term for that lost revenue: "leakage." And keeping a tight hold on patients' medical records is one way to prevent it.

There's a ton of proprietary value in that data, says Blumenthal, who now heads the Commonwealth Fund, a philanthropy that does health research. Asking hospitals to give it up is "like asking Amazon to share their data with Walmart," he says.

3,243

Number of medication errors linked to EHR-usability issues at three pediatric hospitals from 2012 to 2017, according to a *Health Affairs* study

ELECTRONIC LEAPS FORWARD

FHIR
Much optimism lies around FHIR (pronounced "fire"), a standard for an open API that allows for health data exchange (and which the government has proposed requiring). Developers are working furiously on innovative applications that layer on top of existing EHRs (like apps for an iPhone) to make data more searchable and actionable. Apple uses FHIR to pull records onto its HealthKit.

VOICE
Doctors won't have to document a thing when the EHR understands what's being said and can write the note itself. Advances in voice recognition make this a not-too-far-off reality.

MOBILE
The major EHR vendors have introduced mobile platforms that allow physicians to chart on more intuitive and portable touch screens.

HUMAN SCRIBES
Doctors rave about this low-tech EHR "accessory." Hired to shadow doctors and take notes for them, scribes lighten the load but cost a lot.

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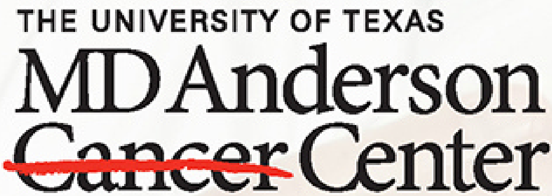

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Blumenthal acknowledges that he failed to grasp these perverse business dynamics and foresee what a challenge getting the systems to talk to one another would be. He adds that forcing interoperability goals early on, when 90% of the nation's providers still didn't have systems or data to exchange, seemed unrealistic. "We had an expression: They had to operate before they could interoperate," he says.

In the absence of true incentives for systems to communicate, the industry limped along; some providers wired up directly to other select providers or through regional exchanges, but the efforts were spotty. A Cerner-backed interoperability network called CommonWell formed in 2013, but some companies, including dominant Epic, didn't join. ("Initially, Epic was neither invited nor allowed to join," says Sumit Rana, senior vice president of R&D at Epic. Jitin Asnaani, executive director of CommonWell counters, "We made repeated invitations to every major EHR ... and numerous public and private invitations to Epic.")

Epic then supported a separate effort to do much the same.

Last spring, Verma attempted to kick-start the sharing effort and later pledged a war on "information blocking," threatening penalties for bad actors. She has promised to reduce the documentation burden on physicians and end the gag clauses that protect the EHR industry. Regarding the first effort at least, "there was consensus that this needed to happen and that it would take the government to push this forward," she says. In one sign of progress last summer, the dueling sharing initiatives of Epic and Cerner, the two largest players in the industry, began to share with each other—though the effort is fledgling.

When it comes to patients, though, the real sharing too often stops. Despite federal requirements that providers give patients their medical records in a timely fashion, in their chosen format, and at low cost (the government recommends a flat fee of $6.50 or less), patients struggle mightily to get them. A 2017 study by researchers at Yale found that of America's 83 top-rated hospitals, only 53% offer forms that provide patients with the option to receive their entire medical record. Fewer than half would share records via email. One hospital charged more than $500 to release them.

Sometimes the mere effort to access records leads

to court. Jennifer De Angelis, a Tulsa attorney, has frequently sparred with hospitals over releasing her clients' records. She says they either attempt to charge huge sums for them or force her to obtain a court order before releasing them. De Angelis adds that she sometimes suspects the records have been overwritten to cover up medical mistakes.

Consider the case of 5-year-old Uriah R. Roach, who fractured and cut his finger on Oct. 2, 2014, when it was accidentally slammed in a door at school. Five days later, an operation to repair the damage went awry, and he suffered permanent brain damage, apparently owing to an anesthesia problem. The Epic electronic medical file had been accessed more than 76,000 times during the 22 days the boy was in the hospital, and a lawsuit brought by his parents contended that numerous entries had been "corrected, altered, modified and possibly deleted after an unexpected outcome during the induction of anesthesia." The hospital denied wrongdoing. The case settled in November 2016, and the terms are confidential.

More than a dozen other attorneys interviewed cited similar problems, especially with gaining access to computerized "audit trails." In several cases, court records show, government lawyers resisted turning over electronic files from federally run hospitals. That happened to Russell Uselton, an Oklahoma lawyer who represented a pregnant teen admitted to the Choctaw Nation Health Care Center in Talihina, Okla. Shelby Carshall, 18, was more than 40 weeks pregnant at the time. Doctors failed to perform a cesarean section, and her baby was born brain-damaged as a result, she alleged in a lawsuit filed in 2017 against the U.S. government. The baby began having seizures at 10 hours old and will "likely never walk, talk, eat, or otherwise live normally," according to pleadings in the suit. Though the federal government requires hospitals to produce electronic health records to patients and their families, Uselton had to obtain a court order to get the baby's complete medical files. Government lawyers denied any negligence in the case, which is pending.

"They try to hide anything from you that they can hide from you," says Uselton. "They make it extremely difficult to get records, so expensive and hard that most lawyers can't take it on," he said.

Nor, it seems, can high-ranking federal officials. When Seema Verma's husband was discharged from the hospital after his summer health scare, he was handed a few papers and a CD-ROM containing some medical images—but missing key tests and monitoring data. Says Verma, "We left that hospital and we still don't have his information today." That was nearly two years ago. ■

IF YOU ARE OR WERE A HOLDER OF OR OTHERWISE CLAIM ANY ENTITLEMENT TO ANY PAYMENT IN CONNECTION WITH ANY AMERICAN DEPOSITARY SHARE (SOMETIMES KNOWN AS AN AMERICAN DEPOSITARY RECEIPT) ("ADR") FOR WHICH THE BANK OF NEW YORK MELLON ("BNYM") ACTED AS DEPOSITARY, YOUR RIGHTS MAY BE AFFECTED.

Pursuant to Federal Rule of Civil Procedure 23 and Court Order, the Court has directed notice of the $72.5 million settlement proposed in *In re: The Bank of New York Mellon ADR FX Litigation*, No. 16-CV-00212-JPO-JLC (S.D.N.Y.) to the Settlement Class. If approved, the settlement will resolve all claims in the litigation. **This notice provides basic information. It is important that you review the detailed notice ("Notice") found at the website below.**

What is this lawsuit about:

Lead Plaintiffs allege that, during the relevant time period, BNYM systematically deducted impermissible fees for conducting foreign exchange from dividends and/or cash distributions issued by foreign companies, and owed to ADR holders. BNYM has denied, and continues to deny, any wrongdoing or liability whatsoever.

Who is a Settlement Class Member:

All entities and individuals who at any time from January 1, 1997 through January 17, 2019 held (directly or indirectly, registered or beneficially), or otherwise claim any entitlement to any payment (whether a dividend, rights offering, interest on capital, sale of shares, or other distribution) in connection with, any ADR for which BNYM acted as the depositary sponsored by an issuer that is identified in the Appendix to the Notice. Certain entities and individuals are excluded from the definition of the Settlement Class as set forth in the Notice.

What are the benefits:

If the Court approves the settlement, the proceeds, after deduction of Court-approved notice and administration costs, attorneys' fees and expenses, and any applicable taxes, will be distributed pursuant to the Plan of Allocation set forth in the Notice, or other plan approved by the Court.

What are my rights:

If you receive/have received a Post-Card Notice in the mail, you are a Registered Holder (i.e., you hold (or held) your eligible ADRs directly and your relevant information was provided by BNYM's transfer agent), and you *do not* have to take any action to be eligible for a settlement payment. If you do not receive/have not received a Post-Card Notice in the mail, you are a Non-Registered Holder and you *must submit* a Claim Form, ***postmarked (if mailed), or online, by August 15, 2019***, to be eligible for a settlement payment. Non-Registered Holder Settlement Class Members who do nothing will not receive a payment, but will be bound by all Court decisions.

If you are a Settlement Class Member and do not want to remain in the Settlement Class, you may exclude yourself by request, ***received by May 13, 2019***, in accordance with the Notice. If you exclude yourself, you will *not* be bound by any Court decisions in this litigation and you will *not receive a payment*, but you will retain any right you may have to pursue your own litigation at your own expense concerning the settled claims. Objections to the settlement, Plan of Allocation, or request for attorneys' fees and expenses must be ***received by May 13, 2019***, in accordance with the Notice.

A hearing will be held on **June 17, 2019 at 3:00 p.m.**, before the Honorable J. Paul Oetken, at the Thurgood Marshall U.S. Courthouse, 40 Foley Square, New York, NY 10007, to determine if the settlement, Plan of Allocation, and/or request for fees and expenses should be approved. Supporting papers will be posted on the website once filed.

For more information visit www.bnymadrfxsettlement.com, email info@bnymadrfxsettlement.com or call 866-447-6210.

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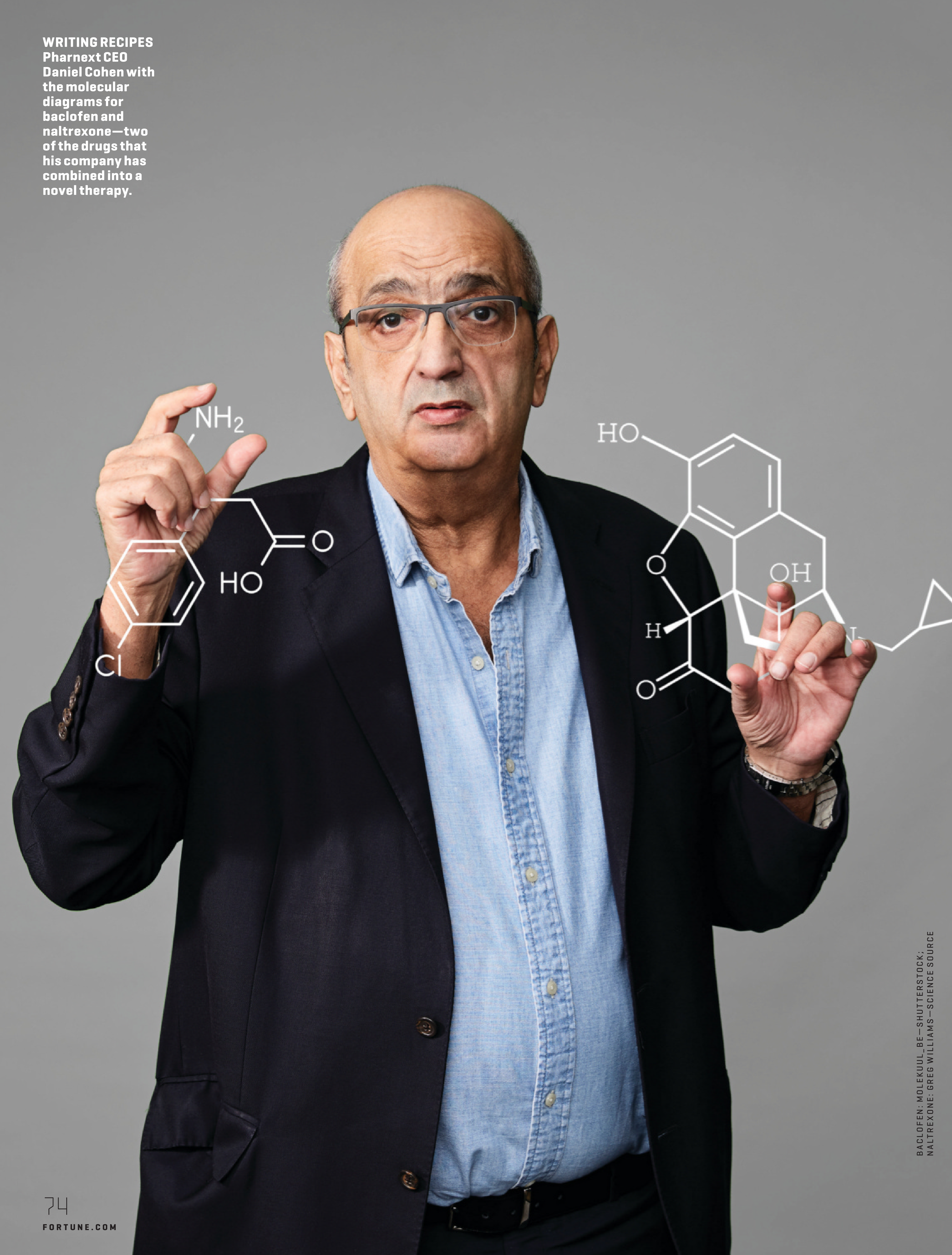
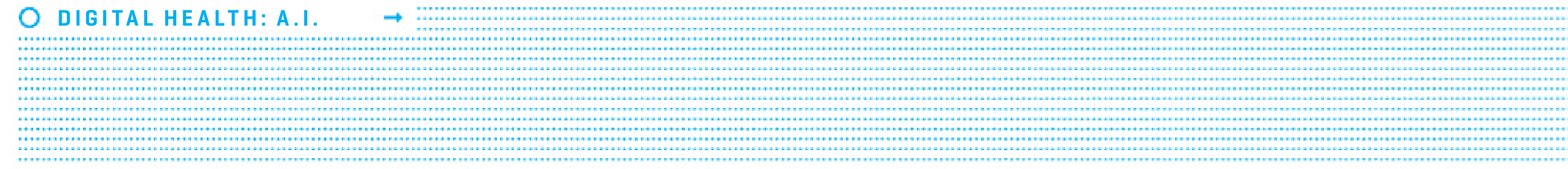


WRITING RECIPES Pharnext CEO Daniel Cohen with the molecular diagrams for baclofen and naltrexone—two of the drugs that his company has combined into a novel therapy.

BACLOFEN: MOLEKUUL_BE—SHUTTERSTOCK; NALTREXONE: GREG WILLIAMS—SCIENCE SOURCE

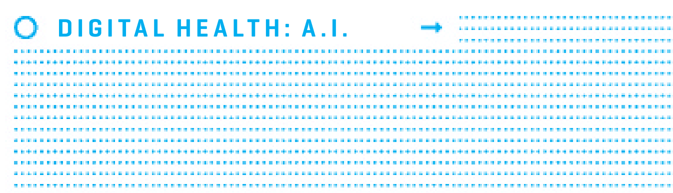


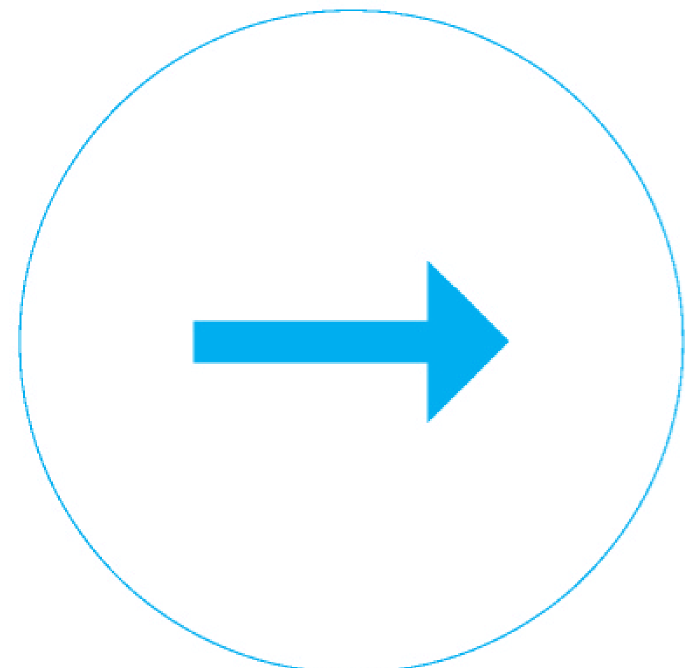
FINDING NEW CURES IN OLD DRUGS

Data-savvy scientists like **DANIEL COHEN** of Pharnext are using **ARTIFICIAL INTELLIGENCE** to figure out how to turn combinations of existing drugs into promising new therapies. Can they unclog Big Pharma's drug pipeline?

BY TIERNAN RAY

PHOTOGRAPH BY **ROBERTO FRANKENBERG**





In theory, with repurposing "you don't need to design new drugs," says Cohen. "With 50 drugs, we can treat everything."

IN THE ELEGANT QUIET of the café at the Church of Sweden, a narrow Gothic-style building in Midtown Manhattan, Daniel Cohen is taking a break from explaining genetics. He moves toward the creaky piano positioned near the front door, sits down, and plays a flowing, flawless rendition of "Over the Rainbow."

If human biology is the scientific equivalent of a complicated score, Cohen has learned how to navigate it like a virtuoso. Cohen was the driving force behind Généthon, the French laboratory that in December 1993 produced the first-ever "map" of the human genome. He essentially introduced Big Data and automation to the study of genomics, as he and his team demonstrated for the first time that it was possible to use super-fast computing to speed up the processing of DNA samples.

Scientists worldwide have built on Cohen's insights, and Cohen himself, an MD with a Ph.D. in immunology, has gone on to success as a researcher and pharma executive. But a quarter-century later, genomics has yielded few of the kinds of paradigm-changing medical breakthroughs that many of its early innovators hoped for. Today, as chief executive and founder of Paris-based drug startup Pharnext, Cohen is striving to understand why that rainbow hasn't led to a pot of gold.

"Any protein in the body has many different functions, not only one," he says, returning from the piano to talk with me, "just as you are a person who has many functions in the population, not just one." The phenomenon Cohen is describing is "pleiotropy," the capacity of a single gene to have multiple, seemingly unrelated effects. It is one of the complexities of disease that has repeatedly frustrated medical researchers in their quest for therapies for the most stubborn illnesses.

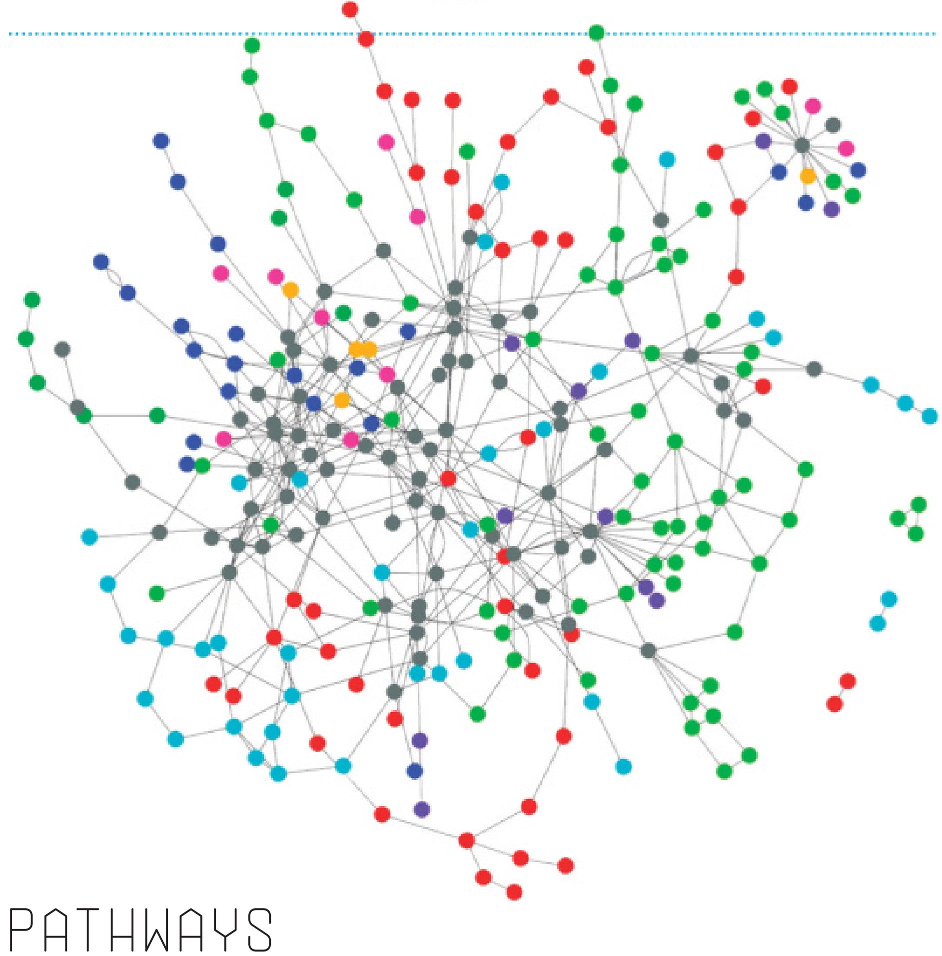
Cohen not only appreciates pleiotropy's significance: He believes that Pharnext and other drugmakers may soon exploit it—with a powerful boost from artificial intelligence. By embracing the body's complexity, and by using A.I. to more methodically analyze and map the way the chain reactions of disease sweep through the body, he hopes to develop combinations of drugs tuned to attack a plethora of medical conditions.

Cohen and his team are also applying A.I. to search for therapies that leverage "repurposing"—combining existing drugs in ways that give them therapeutic powers that each lacks in isolation. Their long-term goal is a drug pipeline that is far more efficient than Big Pharma's notoriously slow R&D departments—streamlined by machine learning. Cohen's sleepy gaze widens with enthusiasm when he describes how it's all coming along. "*Très bien,*" he says. "*Très économique.*"

Running in the same race as Pharnext are companies ranging from giants like Google and IBM to startups such as Insilico Medicine, Recursion Pharmaceuticals, and BenevolentAI. All are deeply invested in the tools of A.I., using them to analyze millions of examples of drug and patient data and tease out patterns of significance. But Pharnext, founded in 2007, predates most of those competitors by several years—and has a longer head start when one factors in Cohen's decades of earlier research in genomics and pleiotropy.

And perhaps most important, Pharnext's application of A.I. to medical problems over the course of more than a decade has finally reached a critical inflection point. In October, Pharnext reported positive results for a Phase III trial in humans of one of its drug combinations. The compound is PXT3003, a treatment for a neurodegenerative condition called Charcot-Marie-Tooth disease (CMT), a rare disorder for which no cure has been found. The primary cause of CMT is duplication of a single gene, but a whole cascade of bad things ensues "downstream" from that mutation. Schwann cells, which protect nerves, regress into stem cells that don't do their job. Axons in the nerves begin to die off. Muscles can't be controlled, and they shrink as a consequence.

According to Pharnext, its Phase III results (which have not yet been peer-reviewed) showed CMT not merely stabilizing under PXT3003 but also being reversed, as cells began regenerating. Previous treatments, Cohen says, had managed only to slow patients' decline. Under PXT3003, patients showed statistically significant improvement on two measures of disability. Based on



PATHWAYS

● To help find therapies, A.I.-driven startups build maps that show how genes, proteins, and the body interact as diseases progress. This illustration depicts Pharnext's map for CMT, a neurodegenerative condition.

those results, in February the U.S. Food and Drug Administration granted Pharnext "fast track" status for that therapy—an accelerated review process, awarded only when the agency thinks a drug demonstrates "superior effectiveness" in treating a serious disease

It is, to be sure, only one hopeful step against one rare ailment. Still, technology has shortened Pharnext's path in ways with promising long-term implications, shaving years off the drug-design timeline. Preclinical testing and clinical trials generally take eight to 10 years, and developing a novel drug completely from scratch can add seven years to the process, sometimes much more. In the case of PXT3003, in contrast, A.I. helped Pharnext select three existing drugs to repurpose: baclofen, a muscle relaxant; naltrexone, used to treat opioid dependence; and sorbitol, a glucose reduction used as a laxative. Because the drugs were already in use, Pharnext could skip the Phase I trials normally required to ensure their safety—and eliminate the "build from scratch" stage.

FDA fast-tracking increases the odds that PXT3003 could be on the market as soon as 2020—and it's only one of Pharnext's many projects. The company will soon begin a second Phase II trial of a drug with indications for Alzheimer's and a first Phase II trial for an ALS therapy, in both cases using a similar repurposed combination.

Just as important: If these experiments succeed, copycats with deeper pockets could follow suit. Kathleen Sebelius, a secretary of Health and Human Services in the Obama administration who is now a consultant and board member for several health care companies, sees the efforts as part of a growing trend to repurpose. "That all leads to the possibility of a lot shorter investment cycle, and potentially a very different pricing point, and lots of possibilities for rare diseases where there just hasn't been enough of a financial incentive," she says. "And that has lots of appeal." Eric Kandel of the Kavli Institute for Brain Science at Columbia University, a winner of the Nobel Prize in physiology or medicine who is an adviser to Pharnext, says that the startup is at the leading edge of the trend, calling its methodology "both original and powerful." As for whether that approach will catch on widely, Kandel adds, "We should know soon."

AT THE DAWN of modern genetic research, almost no one anticipated the enormous complexity in the biology of disease. Many researchers thought the genome would be a kind of instruction manual for the body. Pioneers such as Celera Genomics' Craig Venter and Francis Collins of the National Institutes of Health were celebrated as "gene hunters," a term that evoked crusaders scouring the globe for that one "silver bullet" gene that would explain—and facilitate a cure for—a given disease.

To some extent, these researchers found real treasure. Geneticist Nancy Wexler, for example, spent years in Venezuela compiling family trees of those affected by Huntington's disease, a rare, inherited condition. Her work led to the discovery of the mutation in a single gene that predicts whether an individual will contract the condition.

But scientists soon realized that genetic maps were less like an instruction manual and more like the parts catalog you get with Ikea furniture. What's more, researchers discovered other catalogs that added complex variables to the relationships between genes and disease—for example, the proteome, the proteins encoded by DNA, and the transcriptome, all the nucleic acids that convert DNA into proteins.

The morning-after disappointment has proved wrenching, as researchers learned that complex diseases, such as cancer and Alzheimer's, didn't yield to a single gene. (Even Huntington's, its gene identified, has remained untreatable.) Today, Cohen and others see a link between the obsession with simplicity and a decline in drug discovery. That decline shows itself in the 1-in-10 success rate for FDA

COURTESY OF PHARNEXT

approval of new therapies; in spiraling costs for drug development (what a Tufts study recently identified as "the $2.6 billion pill"); and in the soaring prices of the few treatments that break new ground, such as the $475,000 cost of a course of treatment with Novartis's leukemia drug Kymriah.

More recently, researchers have begun to grapple with biological complexity with the help of the science of networks. That science's chief evangelist is Albert-László Barabási, a professor at Northeastern University whose 2014 book *Linked* popularized the notion that network theory can explain numerous fields, from fashion trends to sexual relations to disease. Barabási and others realized that disease is like a bad signal that moves through a network of connections from genes to proteins to cells to tissues, until all these "perturbations" manifest as the familiar symptoms of disease.

Complicated diseases are confluences of numerous effects, because pleiotropy means that any given protein can act at different points in the body. Startups like Pharnext assume that drugs can also be pleiotropic, acting on more than one protein and more than one interaction in the body at the same time. To find a drug combination capable of tackling complexity, the enormous power of machine learning, with its ability to spot patterns in data, must be wedded to a sense of the structure by which disease operates.

This, in turn, has required an evolution in the relationship between computer scientists and biologists. Newer machine-learning approaches ingest vastly more data and can assemble hierarchies of information that let them go beyond correlation. Still, harnessing these "deep learning" neural networks into a structure that has any predictive power requires some elegant algorithm-building.

Colin Hill, CEO and founder of GNS Healthcare, is one of the builders. His company, based in Cambridge, Mass., has spent 18 years developing a computer system called REFS, which stands for "reverse engineering, forward simulation." GNS has raised a total of $38 million over the years—from Amgen Ventures, the venture capital arm of the drug giant, along with Celgene and a variety of other investors—to build and fine-tune its models of disease. And in a recent series of trials, first published in 2017 in the medical journal *The Lancet,* GNS has detailed REFS's potential when applied to a disease such as Parkinson's—an ailment in which pleiotropic factors render existing treatments wildly hit-or-miss in their effectiveness.

With Parkinson's, the network of interactions set in motion by defective genes has a particular shape to it, and the breakdown of motor functioning is the most reliable indication of its progression. Feeding the genetic data of Parkinson's sufferers and a control group into REFS helped GNS generate over 100 computer models depicting what might be going on as motor function deteriorates. The models can uncover previously unknown genetic mutations that may contribute to the speedup of deterioration.

But that's just the first part. GNS has used those findings to create 5,000 different computer simulations of randomized control trials, each aiming to predict how fast the disease would progress with varying approaches to treatment. Such speed-testing can be vastly more economical than seeking the same result through controlled human trials. And GNS, in partnership with other drugmakers, is now applying similar approaches to treatments for diabetes, ALS, multiple myeloma, and breast cancer, among other diseases.

"We now have the ability to create and construct, on the computer, representations of human patients and their diseases such that we can now probe, drug by drug, care management intervention by care management intervention, and say what treatments work for which patient," says Colin Hill, CEO of GNS.

The simulation, in other words, is not just finding correlations: It is answering *What if* questions. What if we had given drug A instead of drug B to patient X? That ability to simulate and answer counterfactuals is a recent arrival in the practice of A.I. It owes its growing importance in large part to GNS's technology adviser, Judea Pearl, a longtime A.I. researcher and professor of computer science at UCLA. In a popular volume published last year called *The Book of Why*, Pearl describes how true intelligence ascends from merely noticing patterns, which machine learning does in spades, to being able to express counterfactual reasoning about what would have happened, based on those patterns. Data alone, disconnected from any idea of a mechanism, doesn't provide real insight. "Data is profoundly dumb about causality," claims Pearl. Hill puts it more bluntly: "Deep learning is not that deep."

DANIEL COHEN, NOW 67, spent his childhood in Tunisia's heterogeneous society of Jews, Christians, Muslims, "living all together in a very elegant and pacific way." He credits that experience for his taste for "things that are not complicated, but complex." When he was 9, Cohen's family immigrated to Paris, where he pursued the piano avidly. He switched to medicine once he realized he might have a greater impact as a scientist than a musician, but the passion has not left him. He has been a guest conductor at the Royal Philharmonic in London and dreams of leading that ensemble in Tchaikovsky's *Symphony Pathétique*. "The predisposition to orchestra conductor, CEO, and scientist are all controlled by the same genes," he jokes.

Parlaying genomics and technology into pharmaceutical suc-

cess is something Cohen has done before. He was a cofounder of Millennium Pharmaceuticals, a U.S. oncology-drug maker that helped develop the multiple-myeloma treatment Velcade.

Cohen is bullish that Pharnext can be successful with A.I., but he is also aware of the technology's limitations. Google's AlphaZero, an A.I. program, was able to beat the world's human masters at the Chinese strategy game Go, without using any prior human knowledge. But as Cohen points out, Go has a finite set of rules, which AlphaZero knew completely. In biology, thanks in part to pleiotropy, the rules are not fully known—and may never be.

But thoughtfully designed A.I. has enabled Pharnext to build models around the rules that *are* known and make choices accordingly. Out of the universe of 10,000 known drugs, the company's discovery model takes in an assortment of 2,000 that are both out of patent and "marketed"—that is, already judged both therapeutically effective and safe enough to be sold to the public.

To develop its CMT drug, Pharnext first spent about a year assembling its network model for the disease—a framework comparable to GNS's Parkinson's map, showing how nervous and muscular problems "cascade" from the relevant gene mutation. Based on this mechanism, the computer model arrived at a short list of 57 candidate drugs that addressed various points in the cascade. Pharnext tested those drugs one by one in vitro, generating a shorter list of 22 to be tested in mice, which finally yielded the three-drug combination that went to human clinical trials. The recent positive Phase III results confirmed that the PXT3003 cocktail is acting at various points in the cascade.

Without the A.I. model, many more years of preclinical testing would have been required beyond the three years it took Pharnext, says Cohen. "With 2,000 drugs [to start with], I could produce all possible combinations, a billion possibilities" to test in vitro. That's a recipe for countless false positives and dead ends—years of frustration, for now forestalled.

PHARNEXT'S SHARES, which trade on the Paris stock exchange, have more than doubled since October's Phase III results announcement. The company has spent about 120 million euros ($135 million) over the past decade on research and development—a very modest figure by pharma standards. It has never made a profit, but analysts estimate that if PXT3003 reaches the market, revenue—9 million euros in 2018—could soar starting in 2020. (GNS Healthcare is privately held and does not disclose spending or revenue.)

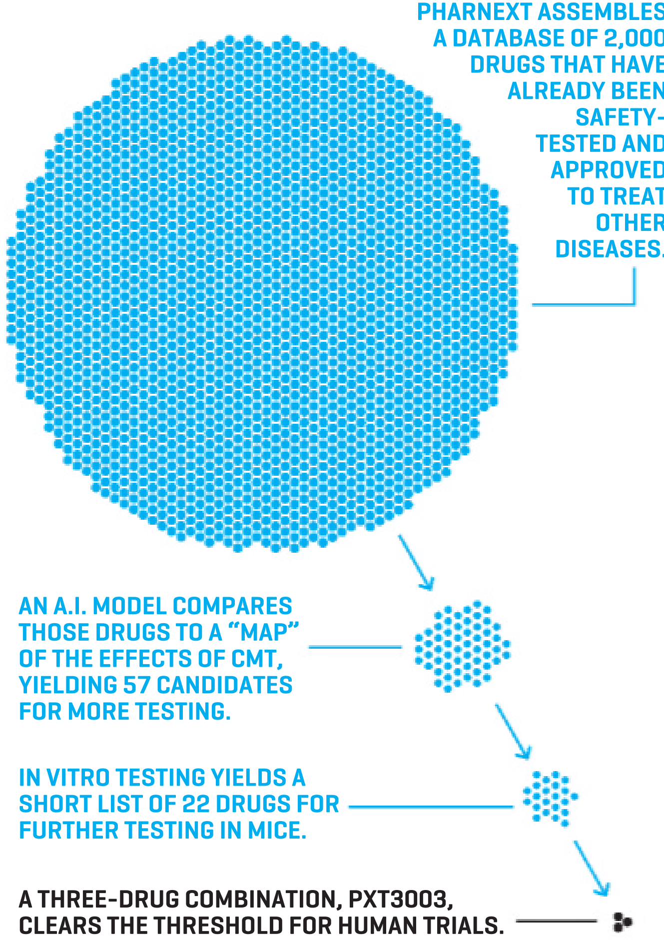
Beyond possible victories for investors, the advances at Pharnext and GNS point the way to A.I.'s growing up—and pharmacology along with it. The ability to reason about causality, and to explore counterfactual questions, is a threshold that users of artificial intelligence have long sought to cross. The computer models at these startups are making a foray in that direction as they manage and tame a bewildering number of variables.

Even the underlying definition of disease may evolve. As scientists are learning, these definitions have been overly simplistic. A study in the journal *Bioinformatics* last year noted that attempts to treat tumors are hampered by the fact that genetic mutations in cancer are "fundamentally heterogeneous": What appears as one disease, or class of disease, in fact contains few commonalities and many differences from patient to patient. As it becomes clear that what's happening in any body differs sharply from the "on/off" model of one gene turning on a set of symptoms, technology can help drug developers wrestle with the complexity.

Last, but hardly least, these A.I.-driven efforts offer a glimmer of economic hope. In an era in which the cost of drug development is a daunting obstacle, smart algorithms may someday enable medical stakeholders to derive more value from the trillions of dollars that have already been spent on drug research. In theory, with repurposing, "you don't need to design [new] drugs," Cohen avers. "My feeling is that with 50 drugs, we can treat everything." That would mean changing yet another definition: the meaning of "discovery." ■

THE BIG SORT

Pharnext uses an A.I. model to search through a database of existing drugs to find new therapeutic combinations—a process that can shave years off the drug-development process. Here's how it helped the company develop PXT3003, a compound to treat CMT.



RIVAL RIDERS GRAB AND GO-JEK MOTORCYCLE-TAXI DRIVERS AND PASSENGERS IN JAKARTA.

RACING IN THE STREETS

SINGAPORE'S GRAB AND INDONESIA'S GO-JEK STARTED OUT AS SCRAPPY TAXI SERVICES. NOW THEY'RE EXPANDING INTO BANKING, GROCERIES, AND MORE—AND JOCKEYING TO OFFER THE TOP "SUPER-APP" IN SOME OF THE WORLD'S FASTEST-GROWING ECONOMIES.

BY ***CLAY CHANDLER***

WE ALL SCREAM FOR ICE CREAM.

THAT'S THE IDEA BEHIND ICE CREAM DAY, a promotion launched by Uber Technologies in 2012. The ride-share giant courts customers by allowing them, for one day each summer, to arrange instant dessert delivery through the Uber app. But in June 2015, as the American powerhouse expanded that campaign across 53 countries, Malaysian entrepreneur Anthony Tan saw a chance to cast Uber as an outsider—and burnish the appeal of his homegrown ride-hailing venture, Grab.

Just after Uber's event, Grab offered what Malaysians *really* scream for: smelly durians. Customers in Kuala Lumpur, the capital, could have one of the pungent fruits rushed to their doorstep by a Grab driver. To deliver on that promise, Grab had to devise special packaging: Durians, though considered a great delicacy, emit an odor so overpowering that they are banned in many airports and hotels. Grab surmounted that obstacle and offered the fruits at the bargain price of a single ringgit (24¢). They sold out almost immediately, and the "GrabDurian" marketing coup is now well into its fourth year.

"No foreigner would have thought to do that," chortles Tan. Uber, he says, "couldn't fully appreciate how local you needed to go" to win in Southeast Asia.

Grab has employed hyperlocal strategies with remarkable success. Since its 2012 launch from a warehouse closet in a gritty Kuala Lumpur suburb, the venture has expanded to eight countries. It boasts 2.8 million drivers—more than the 2 million claimed by Uber. Grab says its app has been downloaded to 139 million devices and that it processes more than 6 million ride orders a day. Grab's 2018 revenue topped $1 billion, and it expects to double that figure this year. Along the way, it outlasted its ice-cream-peddling rival: In March 2018, Uber announced that it would sell its Southeast Asian operations to Grab in exchange for a 27.5% stake in the company and a seat on its board.

Tan, 37, and cofounder Hooi Ling Tan (a 35-year-old fellow Malaysian to whom Anthony is not related) have aspirations stretching far beyond the taxi business. They aim to transform Grab into an "everyday super-app" that engages consumers on multiple fronts—offering food delivery, digital payments, financial services, and even health care along with rides. Most of the region's 650 million consumers are only now getting access to conveniences long taken for granted in China and the West; Grab hopes to be the app that connects them to whatever goods and services they demand.

With a 2017 GDP of $2.8 trillion, Southeast Asia, were it a single country, would be the world's seventh largest economy; at its current growth rate, it would rank No. 4 by 2030. But for investors, market size is only part of the appeal. Super-apps promise a new mode of connecting with customers and an opportunity to amass a vast data trove about their preferences and purchasing behavior. It's a model pioneered in China by Alibaba's Alipay and Tencent's WeChat; Mark Zuckerberg, in a recent blog post, hinted that he hopes Facebook can emulate it. Many believe revenue from super-app services and the data they generate will prove to be more stable, more profitable, and easier to scale than revenues from ride-hailing—where profits have been elusive even as growth skyrockets.

In Southeast Asia, the super-app model is evolving more rapidly than anywhere else in the world. That helps explain why Grab has raised $8.6 billion in venture funding from powerful players including Japan's SoftBank Group and Toyota Motor, Chinese ride-hailing giant Didi Chuxing, and Microsoft. Grab's most recent funding round values it at more than $14 billion, making Grab Southeast Asia's most valuable unicorn.

Grab prevailed over Uber, Anthony argues, because it adapted to local consumers' needs. In a relatively low-income region, Grab provided a platform for cheap taxis and motorcycles to counter Uber's expensive "black cars." And while Uber required payment by credit card, Grab created a network of intermediaries to help "unbanked" customers pay cash. (Plus, those durians!)

But in Grab's latest battle, it doesn't hold home-court advantage. Grab has moved its headquarters to Singapore, but Anthony Tan has recently been spending more than 70% of his time in Indonesia. Many analysts believe that winning there is crucial to establishing regional digital hegemony. Indonesia accounts for 40% of Southeast Asia's GDP, and it boasts unusually tech-savvy consumers: 74% of Indonesians with mobile Internet access make e-commerce purchases, the highest figure in the world, according to social media management platform HootSuite.

Here's the rub: Across the archipelago, Grab's drivers must vie for passengers with rivals from Go-Jek, an Indonesian venture whose backers include Google and Tencent. Go-Jek employs more than a million drivers and processes more than 100 million transactions for 25 million monthly users. Go-Jek is also a super-app: The venture's 18 on-demand services include Go-Mart (grocery shopping), Go-Clean (housecleaning), Go-Glam (hairstyling and makeovers), and Go-Massage (self-explanatory). Go-Jek claims 108 million app

PREVIOUS SPREAD: DIMAS ARDIAN—BLOOMBERG VIA GETTY IMAGES

● **CAB FARE** ANTHONY TAN AND HOOI LING TAN STARTED GRAB WITH $25,000 IN PRIZE MONEY FROM A BUSINESS SCHOOL PITCH CONTEST.

downloads and says at least half of those who have used its app have also used its payment service, Go-Pay.

Go-Jek's founder, 34-year-old Nadiem Makarim, harbors regional ambitions of his own—and he says the two Tans ripped off his super-app model. "It's really interesting that Grab has started to try to take that word away from us," Makarim says. "I'm like, 'Excuse me?' You spend the first years of your life copying Uber? And then the next three years of your life copying Go-Jek?" Makarim's jab elicits a pointed rejoinder from Grab, whose founders make no claim to inventing the concept. In an email to *Fortune*, the Tans note that "having a good idea does not guarantee success."

The exchange hints at the personal acrimony that has crept into the rivalry between Makarim and the Tans. It's a contempt rooted in familiarity: All three were classmates at Harvard Business School, and they once considered one another kindred spirits.

UNTIL RECENTLY, Grab and Go-Jek mostly stayed out of each other's lanes. Now, as their business models and target markets converge, the two seem to be on a collision course. In many cities, the companies have embarked on a no-holds-barred price war, slashing fees for car rides, motorcycle trips, and other services. The conflict can be visually bewildering. In Indonesia, both ventures have adopted green as their corporate color, with Grab's drivers clad in forest and Go-Jek's decked in a shade of kelly verging on lime. In Jakarta, the combined fleets have transformed major thoroughfares into pulsing rivers of green.

For now, Grab is the front-runner. It operates in more markets than Go-Jek and holds e-payment licenses in the region's six largest markets. (Go-Jek offers such services only in Indonesia and the Philippines.) With its Uber acquisition, Grab has the ride-hailing market-share lead in Singapore, Malaysia, the Philippines, and Vietnam, though Go-Jek competes in each. Even in Indonesia itself, Grab holds 62% of the ride-share market, according to ABI Research, although Go-Jek disputes that figure.

Still, Go-Jek is a formidable foe. The venture has raised $3.1 billion, according to Crunchbase, and analysts estimate its valuation at $11 billion. And Makarim argues that Go-Jek's breadth of services will win out over time. Although ride-hailing business lines at both ventures are widely believed to lose money, Makarim claims Go-Jek is close to profitability in its non-transport segments. (Neither company publicly breaks out revenue figures by business line.)

Investors find the race increasingly fascinating—and tough to handicap. "People tend to interpret the fact that Grab has raised so much money so quickly as a sign of strength," says Jason Davis, an associate professor of entrepreneurship at the business school Insead in

STEFAN CHOW

Singapore. But in his opinion, Grab has "stretched itself beyond its capacity" in its expansion. Davis teaches a case study on ride-hailing ventures. At the outset, he asks students to vote on which one they would have wanted to invest in. "Everyone begins saying Grab, maybe Uber," he says. "Go-Jek is usually a distant third." By the end of the course? "It's Go-Jek, Grab, Uber."

THIS BATTLE ARGUABLY BEGAN in a classroom at Harvard. There, in the spring of 2011, the Tans and Makarim enrolled in "Businesses at the Base of the Pyramid" (also known as "B-BoP"), taught by senior lecturer Michael Chu. The course takes its name from a thesis popularized by business scholars C.K. Prahalad and Stuart L. Hart, who argued that the biggest opportunities in emerging markets lay not in catering to the affluent but in serving the billions of aspiring poor joining the market economy for the first time.

Hooi Ling Tan and Makarim were friends before coming to Harvard. Both had worked as consultants at McKinsey, she in Kuala Lumpur and he in Jakarta. Neither knew Anthony, but both knew of him—the gregarious youngest son of Tan Heng Chew, one of Malaysia's most prominent industrialists.

All three shared a frustration with the failings of their home countries' transportation systems. For Hooi Ling, a self-described "gadget freak" with a degree in mechanical engineering, the main defect was safety. In her teen years, Kuala Lumpur's taxis were considered so unreliable that, even to meet friends at the mall, she had to be driven by a family member. During her McKinsey stint, her mother, a stockbroker, would wait up well past midnight to monitor her return home.

Anthony shared those concerns, along with a sense of opportunity. The summer before business school, he and a friend tried to run a taxi service with a fleet of 40 rented cars—but they couldn't figure out how to match cars and riders. For Anthony, whose grandfather was a taxi driver, the prospect of solving that problem using smartphones, as Uber was doing in the U.S., was enticing. But it was also fraught. His father expected him to join the family business, which manufactures and distributes Nissan vehicles throughout the region. Launching a venture of his own, Anthony knew, would be tantamount to open rebellion in a household that prized obedience. "It was really tough," he recalls. "My dad, you know, he's very Confucian."

In the end, the logic of the opportunity prevailed. Hooi Ling and Anthony teamed up to enter HBS's annual business plan contest with a proposal for an app-based taxi-hailing service tailored to Southeast Asia. They came in second, earning $25,000—enough seed money to launch a venture they called MyTeksi.

Makarim, a U.S.-educated scion of a family prominent in Indonesian law and politics, saw B-BoP as a way to get credit for a business he had already started. He launched Go-Jek as a side hustle in 2010. Go-Jek takes its name from *ojek*, the Bahasa Indonesian word for the country's millions of motorbike-taxi drivers. In Jakarta, a sprawling metropolis of 30 million, *ojeks* have long been the fastest, cheapest way to cut through the legendary gridlock. Working in Jakarta, Makarim, too, had struggled to get around. "I had my own driver," he recalls. "And yet I'd always end up using these motorcycle guys because I was always running late."

By Makarim's own admission, *ojeks* were an imperfect solution. "They were never around when you needed them," he recalls, and their reputation for haggling led many passengers to disdain them. Still, he saw them as an untapped resource that, if professionalized, might alleviate everyone's least favorite thing about Jakarta. Makarim recruited 20 *ojeks* and a couple of dispatchers—and bought everyone green jackets.

Grab's first venture investor was Anthony Tan's mother, who confessed she didn't understand his business model but hoped it would succeed because his father—who had already turned Anthony down—was threatening to disinherit him from the family's considerable fortune. By late 2014, MyTeksi had amassed more than $80 million and had expanded to the Philippines, Singapore, Thailand, and Vietnam under a new brand, GrabTaxi. But its burn rate was high, as

TAXIS PLUS NADIEM MAKARIM'S GO-JEK OFFERED FOOD DELIVERY AND COURIER SERVICES FROM EARLY ON, IN PART SO DRIVERS WOULD HAVE WORK OUTSIDE OF RUSH HOUR.

JIRO OSE

TAKING THE RACE OFF-ROAD

Grab and Go-Jek position themselves as "super-apps," wooing customers in fields far beyond the taxi business. Here are some other industries in which they compete head-to-head.

MOBILE FINANCE

Both Grab and Go-Jek hope to borrow a page from China's Alipay and WeChat apps, whose "digital wallets" can be used to pay for just about everything. GrabPay operates in six Southeast Asian nations—and could go wider with help from a new prepaid-card partnership with Mastercard. Through Grab Financial Services, Grab offers loans to local consumers and entrepreneurs who otherwise have no bank accounts, using their digital-payment histories to help establish creditworthiness.

Go-Jek's Go-Pay system currently operates mostly in Indonesia; the company says it's on pace to process well over $6 billion worth of transactions this year.

MOBILE GROCERIES

After Go-Jek launched its app in 2015, Go-Food quickly became one of its most popular menu options. Founder Nadiem Makarim originally saw prepared-food delivery as a way to keep drivers busy during off-peak hours. But it's now a sales driver in its own right, processing more than $2 billion worth of food deliveries a year. Go-Jek users can also order groceries through Go-Mart.

The GrabFood restaurant-delivery service expanded dramatically in early 2018, when Grab bought the Southeast Asian operations of Uber—including UberEats. Grocery delivery joined the portfolio in August, when Grab launched GrabFresh in partnership with Malaysian delivery service HappyFresh.

MOBILE MISCELLANY

To combat the epic gridlock in Jakarta and other Indonesian cities, Go-Jek has deployed its motorcycle-taxi fleet to bring on-demand services to its customers, with options including Go-Clean (housekeeping), Go-Glam (hairstyling and makeovers), and even Go-Massage.

There's no GrabDrug or GrabDoctor—at least not yet—but Grab in August announced a joint venture with China's Ping An Healthcare and Technology to explore delivering medical consultations via app, along with medicine delivery and appointment booking.

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the Tans offered aggressive promotions for drivers and discounts for passengers.

In December 2014, as Uber's private-market valuation soared past $40 billion, Anthony was summoned to Tokyo to meet with SoftBank chairman Masayoshi Son—one of the world's most influential tech investors. After an hour of conversation, Son cut to the chase: He intended to play godfather in ride-hailing, and he was making an offer Tan shouldn't refuse. ("You don't take my money, not so good for you," Tan recalls Son saying.)

SoftBank reportedly invested $250 million in GrabTaxi, for a stake whose size neither company has disclosed. So far, for both Tan and Son, that investment has proved good indeed. SoftBank has led several more fundraising rounds for Grab, most recently for $1.46 billion in early March. And Son, who also is a major shareholder in Uber, played a decisive role in persuading that company to sell out to Grab.

Son's investment initially sounded like bad news for Go-Jek. But global investors were beginning to scramble for opportunities to invest in the ride-hailing model outside the U.S., and Son's Grab stake only fed the frenzy. Makarim offered these investors a new angle: a super-app model.

Go-Jek had been a multiservice venture from the outset. To keep drivers employed all day, not just during rush hours, Makarim had encouraged them to supplement passenger transport with courier services, meal delivery, and other endeavors. Shortly after the Go-Jek app launched in January 2015, it offered three options: Go-Bike, Go-Send, and Go-Food. American backers decried the menu as messy and confusing, but Indonesian users voted with their thumbs. Within a year, Go-Jek had been downloaded more than 11 million times. Makarim kept adding services. He told a tech conference in Jakarta later that year, "If you want something, whatever it is, in 60 minutes, as long as it's legal, then you can get it on the Go-Jek app."

The omnibus sensibility helped Go-Jek break through. In October 2015 it won funding from Singapore's NSI Ventures and Sequoia Capital. In 2016 it raised $550 million in a round led by private equity firms KKR and Warburg Pincus, vaulting Go-Jek into the unicorn club. By the time Grab joined the super-app battle, rolling out the payment platform GrabPay late in 2017, both companies had plenty of financial ammunition for the fight.

LIKE GUNPOWDER, PASTA, and paper money, the super-app is an innovation generally credited to China. Among the earliest incarnations was Alipay, the payment function created by Alibaba in 2004 in tandem with its Taobao e-commerce platform. Alipay has evolved into China's dominant mobile-payment method, a digital wallet linked to bank accounts and credit cards and used to pay bills, transfer money to friends, book a hotel—or do just about anything else. Even more versatile is WeChat, launched by Tencent Holdings in 2011. WeChat was originally designed to exchange text messages and photos, but Tencent added an Alipay-like digital wallet function, along with a host of social features to make the app quicker, quirkier, and stickier.

For the tech giants who run them, China's super-apps are a data El Dorado. Unlike in the U.S., where Google, Facebook, Amazon, and other tech leaders wrangle and squabble over disparate streams of data reflecting different aspects of consumer behavior, Alibaba and Tencent hoover up information across the spectrum, generating 360-degree profiles of hundreds of millions of users. Such data raises weighty privacy concerns—but for now it remains an asset that companies can monetize in relationships with advertisers and vendors, and through new products of their own.

In emulating China's apps, Grab and Go-Jek faced an added hurdle: the limited reach of Southeast Asia's banks. In China, more than 80% of adults have access to a bank account. Malaysia and Thailand have similar rates. But in Indonesia, the figure is only about 50%, while in the Philippines and Vietnam, it falls below 35%. Those disparities reflect wide variation in economic development, as well as fragmented infrastructure and far-flung geography. (Indonesia alone encompasses 17,000 islands.)

How to create a super-app for millions of consumers who have never even seen a credit card? Go-Jek and Grab have used the Internet and smartphones ingeniously to create armies of mobile tellers. Car and motorbike drivers collect cash and credit it to customers' digital wallets. They toil alongside neighborhood agents who, in addition to topping up the wallets, help consumers who lack bank accounts purchase goods online, pay bills, buy insurance, or apply for loans.

Go-Jek and Grab are dueling for customers in arenas ranging from grocery delivery to medical advice (see sidebar). But the race in financial services has sparked a particularly frenzied burst of dealmaking. Go-Jek tends to prefer partnering through acquisitions, which allows tighter control. In Indonesia, for example, it bolstered its payments dominance in 2018 by acquiring three major financial services companies—an offline payments processor that works with retailers, a payment company that serves online merchants, and a saving and lending network that helps rural and working-class families buy household appliances—and merging the three into its Go-Pay system.

Grab prefers partnerships and joint ventures, which enable it to reach more markets faster—and have helped Grab get an edge outside Indonesia. In October, Grab announced a partnership with Mastercard to issue prepaid cards that Grab customers can spend with any merchant that accepts Mastercard. Grab also has paired up with Japan's Credit Saison to found Grab Financial Services, which now offers loans to unbanked customers—combining Grab's data on consumer behavior with Credit Saison's expertise in credit analysis.

Grab suffered a setback in Indonesia last year when that country's regulators barred ventures with more than 49% foreign ownership from offering digital wallets. But Grab worked around that restriction by acquiring Kudo, an Indonesian payment startup, and partnering with Ovo, a financial services firm owned by Indonesian conglomerate Lippo Group. Lippo's shopping mall holdings give Ovo's smartphone payment system an advantage at shopping centers and restaurant chains. Ovo's users are also relatively affluent—allowing Grab to reach beyond the "base of the pyramid" that Makarim and the Tans studied at Harvard.

EVEN AS GRAB AND GO-JEK expand elsewhere, their original battle over transport rages—in ways that hint at the perils of rapid growth. In Singapore, Grab's acquisition of Uber sparked outrage from drivers, who complained that the combined companies revoked their incentive, and passengers, who protested higher prices and poorer service. (Grab has begun addressing rider complaints, including by eliminating fees for trips canceled within five minutes of booking.)

The rivals are also weathering more scrutiny from regulators. Singapore's competition watchdog imposed fines of $9.5 million on Grab and Uber, ruling that their deal had eroded competition and driven fares up by as much as 15%. The regulator ordered Grab to restore its premerger pricing and told the service to remove exclusivity obligations on drivers and taxi fleets. This would seem to create opportunities for Go-Jek, which has committed $500 million to expanding in Singapore and other markets. But Go-Jek's efforts to establish subsidiaries abroad have also met resistance. In the Philippines, for example, regulators have refused to license one Go-Jek business, citing restrictions on foreign ownership.

Sometimes the upheaval in the industry manifests itself as actual unrest. In October a swarm of angry motorcycle drivers converged on the Lippo Building in downtown Jakarta. Protesters demanded the chance to present a minimum wage proposal to executives from Grab, whose local headquarters are in the building. Denied an audience, the crowd turned violent, smashing the windows of the front lobby, and police cleared the scene with tear gas.

The scrum in Jakarta echoes the volatility of the markets in which Grab and Go-Jek compete—places where rapid growth and the rising expectations of workers and consumers combine to keep conditions at a rapid boil. The turmoil could conclude in a mega-merger in which one of the green-jacketed giants gobbles up the other. But many investors say they now see Southeast Asia's super-app arena as a marketplace in which well-capitalized firms will settle into a long-term competitive standoff, alongside their myriad local partners. "The conventional view used to be that this is a winner-take-all market," says David Katz of KKR, one of Go-Jek's backers. "But no one thinks that now." The race, in other words, has many laps to go. ■

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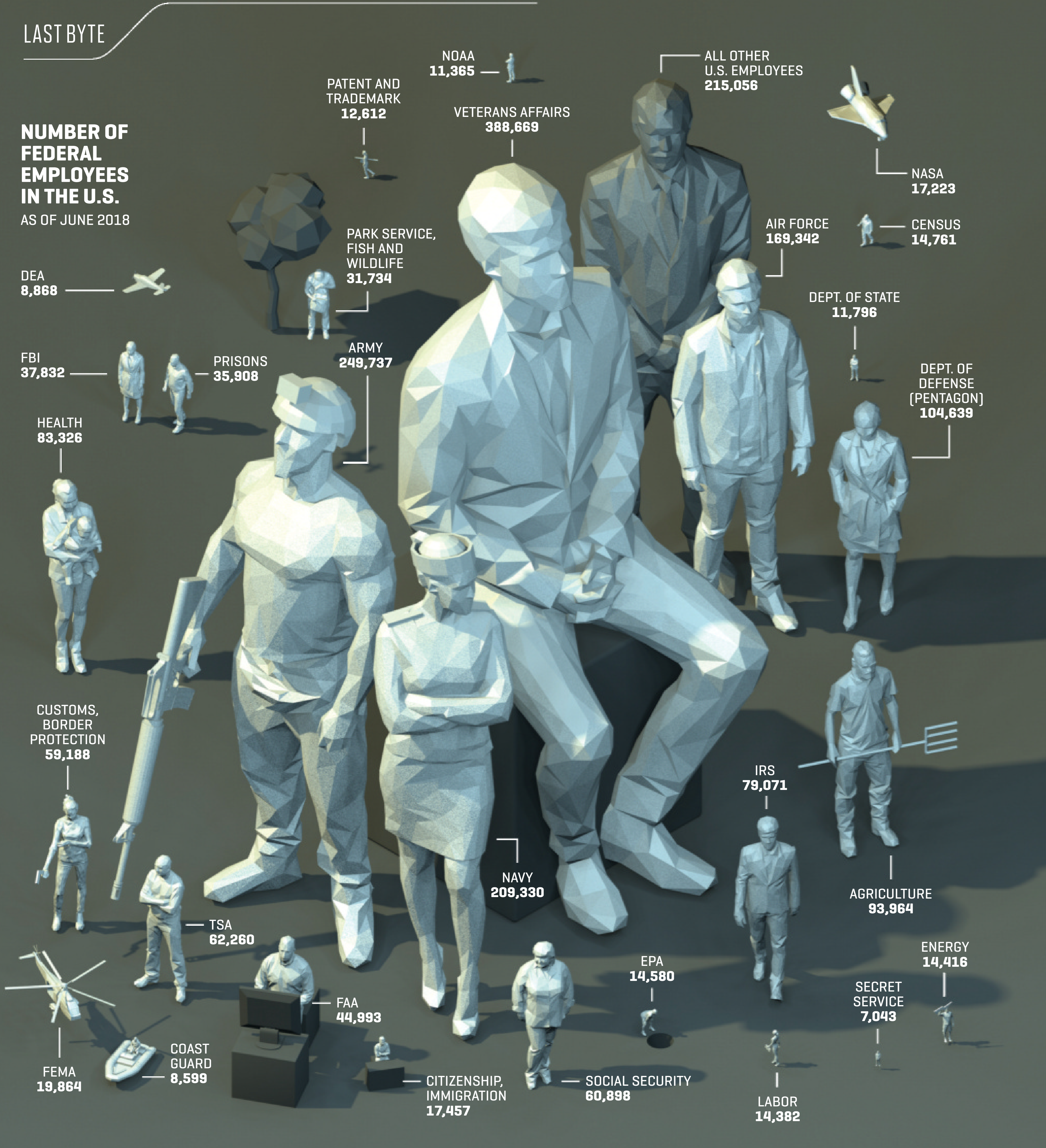

ON THE NATION'S PAYROLL

April 15 is a day that most Americans should feel like a boss. That indelible mark on the calendar—Tax Day—is a reminder, after all, that you've got 2,098,913 people on your payroll, as of June. That said, you may be surprised by where exactly your employees are working: The largest share, for instance, is tasked with taking care of U.S. military veterans (with 90% of staff deployed at VA hospitals). Employment at Veterans Affairs is up 15% over the past five years. Meanwhile, other big federal departments (agriculture, health, housing, and labor) have shrunk. Same goes for the Department of Education, which is actually too small to show on the graphic above. —CLIFTON LEAF

SOURCE: **U.S. OFFICE OF PERSONNEL MANAGEMENT** (EXCLUDES U.S. POSTAL SERVICE)

GRAPHIC BY **NICOLAS RAPP**

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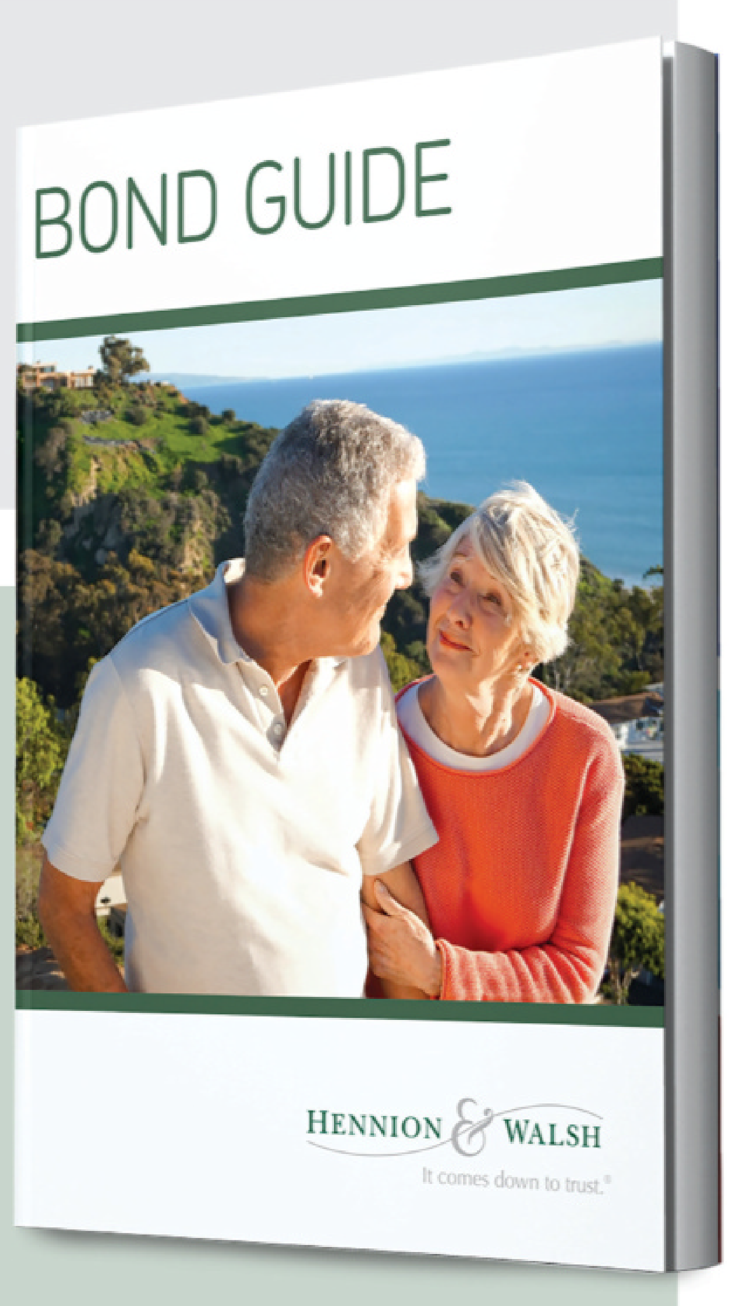

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