



CONTENTS

Introduction: Beyond house calls and ambulance rides 2
The future of mobility 3
Opportunities for providers with new mobility 5
Building a strategy for health care in the future of mobility 9
Endnotes 10

Introduction: Beyond house calls and ambulance rides

The way Americans seek and receive health care seems to shift so often it can be hard to keep up. Providers are taking on financial risk for populations, evaluating ways to improve access and outcomes, and making consumer experience a priority. And more striking developments appear on the horizon.¹

UTSIDE, on the roads leading to doctors' offices and insurers' headquarters, the changes may be even more dramatic, as the way people and goods travel from point A to B heads toward a future expected to be increasingly characterized by shared, autonomous, and seamlessly integrated mobility. The confluence of these transformations could carry very real implications for patients, providers, and more, possibly altering how health is managed and communities are organized.

Even as US health care stakeholders react to and plan for a wide range of challenges and opportunities, they should consider accounting for and leveraging trends in mobility as well. Consider a future in which:

- Demand for trauma care falls as partially and fully autonomous vehicles become increasingly mainstream and road traffic accidents decrease
- Customer access to health care grows as consumers get new options to reach existing providers, and providers develop mobility networks that allow them to access consumers
- Medical supply chain dynamics have fundamentally changed, as nimble transportation net-

works are created and existing models are disrupted, allowing more efficient supply networks

In this new world, business models are unlikely to remain stable, and health care organizations should begin adapting to these changes now. Self-driving cars could be commercially available as early as next year,² and Deloitte's analysis suggests that by 2030 more than 10 percent of miles traveled in the United States could be in shared autonomous vehicles.³

This article explores how these changes could unfold—and how health care providers and supporting players can position themselves in a health ecosystem underpinned by autonomous and shared mobility. We consider how mobility's march toward a more seamless, integrated, and multimodal future might unfold, examining the rapid nature of changes and the potential impact on health care. Finally, we look at key areas in which these changes could most dramatically alter care, from fewer accidents to improved supply chains, and examine how health systems can prepare to capitalize on the future of mobility.

The future of mobility

SERIES of technological and social forces—including the emergence of connected, electric, and autonomous vehicles and shifting attitudes toward mobility—are already beginning to profoundly change the way people and goods move about, affecting a host of industries. Just as the rise of private automobiles enabled health care's consolidation, shared mobility and autonomous vehicles are poised to catalyze health care's next big shift. The new mobility ecosystem could enable the adoption of dispersed-care models and upend the mobility patterns that have long delivered mixed results for population health and well-being.

As these trends unfold, four concurrent "future states" could emerge within a new mobility ecosystem, emanating from the intersection of who owns the vehicle and who operates the vehicle (see figure 1).⁴

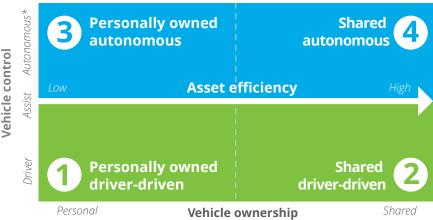
- Personally owned driver-driven: This vision of the future sees private ownership remaining the norm as consumers opt for the forms of privacy, flexibility, security, and convenience that come with owning a vehicle. While incorporating driver-assist technologies, this future state assumes that a fully autonomous drive doesn't completely displace driver-controlled vehicles.
- Shared driver-driven: The second future state
 anticipates continued growth of shared access
 to vehicles through ridesharing and carsharing.
 Economic scale and increased competition drive
 the expansion of shared vehicle services into
 new geographic territories and more specialized
 customer segments. As shared mobility serves a
 greater proportion of local transportation needs,
 multivehicle households can begin reducing
 the number of cars they own, while others may
 eventually abandon ownership altogether.

Figure 1. The future states of mobility

Extent to which autonomous vehicle technologies become pervasive:

- Depends upon several key factors as catalysts or deterrents—e.g., technology, regulation, social acceptance
- Vehicle technologies will increasingly become "smart"; the human-machine interface shifts toward greater machine control

Future states of mobility



Extent to which vehicles are personally owned or shared:

- Depends upon personal preferences and economics
- Higher degree of shared ownership increases system-wide asset efficiency

Source: Deloitte analysis.

 ${\bf Deloitte\ Insights\ |\ deloitte.com/insights}$

^{*}Fully autonomous drive means that the vehicle's central processing unit has full responsibility for controlling its operation and is inherently different from the most advanced form of driver assist. It is demarcated in the figure above with a clear dividing line (an "equator").

- Personally owned autonomous: The third state is one in which autonomous drive technology⁵ proves viable, safe, convenient, and economical, yet private ownership continues to prevail. Drivers still prefer owning their own vehicles but seek driverless functionality for its safety and convenience. This future sees a proliferation of highly customized, personalized vehicles catering to families or individuals with specific needs.
- Shared autonomous: The fourth future state
 anticipates a convergence of both the autonomous and vehicle sharing trends. Mobility management companies and fleet operators offer a
 range of passenger experiences to meet widely
 varied needs at differentiated price points. Taking off first in urban areas but spreading to the
 suburbs, this future state provides seamless mobility across modes that is faster, cheaper, cleaner, safer, and more convenient than today.

These four states are likely to exist in parallel, but the overall trend is likely to be toward a mobility ecosystem that offers integrated multimodal travel enabled by (but not exclusively composed of) shared autonomous vehicles. Still, health care organizations and communities should prepare for and operate in several of these future states, perhaps at the same time, each with distinct implications.



Opportunities for providers with new mobility

VEN as the future of mobility evolves, health care providers and other stakeholders are investing in improving health outcomes and patient experiences. Changes to mobility have the potential to affect health care in a number of areas, examined more closely below:

- The expected reduction in vehicle accidents would impact the demand for trauma care
- The indirect health impacts from, for example, reduced air pollution
- The changes to patient mobility, potentially helping address the problem of no-shows
- Opportunities for making the clinical supply chain and procurement management more efficient

If accidents decline, fewer people would need trauma care

The predominance of driver-driven vehicles imposes a heavy burden on the health care system. In 2012 alone, more than 2.5 million people visited a US emergency room due to motor vehicle crash injuries, resulting in \$18 billion in lifetime medical costs.7 Globally, there are 1.24 million road traffic fatalities each year.8 As advanced crash avoidance systems and autonomous vehicles increasingly fill American roadways, accident rates and the associated financial, social, and health burdens will likely fall. Ninety-four percent of accidents are caused by human error, and automakers are counting on autonomous vehicles eliminating the vast majority of those.9 Already, studies indicate that advanced driver assistance features such as lane departure warnings can reduce rates of injury-causing crashes by more than 20 percent.10 However, realization of

the safety benefits will likely occur in fits and starts as autonomous vehicles and other safety-enhancing improvements (such as connected infrastructure) would coexist with older systems and vehicles. Some researchers predict that road safety could actually worsen during this interim—but that the eventual outcome could be much safer roadways.

With fewer crashes, demand for trauma care will likely decline. In the United States, auto and traffic accidents are the second most frequently cited reason for visiting an emergency room, representing roughly 10 percent of all injury-related visits, a number exceeded only by falls." This will likely amplify the health care industry's shifting focus on advancing overall population health and preventative care. In a fee-for-service world, lower demand for emergency rooms and trauma care would reduce health system revenue; however, to the extent that health systems are sharing the risk for the total cost of care with payers, they should see some savings from patients' better health outcomes.

Cleaner air and shorter commutes may improve chronic health conditions

Beyond the most obvious effect of potentially fewer accidents, the uptick in electric vehicle fleets could reduce pollution and its harmful health effects, especially in dense urban areas. Based on data from roughly 3,000 cities, nearly 80 percent of people living in urban areas are exposed to air pollution—much of it attributable to vehicle emissions¹²—that exceeds World Health Organization recommendations, increasing the risk of a variety of respiratory diseases, heart disease, stroke, and lung cancer.¹³ In OECD countries alone, ambient air

pollution—about 50 percent of it from road transit—cost more than 7 million years of life in 2010.¹⁴

Researchers associate commuting in general—and car commuting in particular—with poor sleep, higher levels of stress, and exhaustion, even after accounting for factors such as age, income, and occupation. ¹⁵ Studies have also linked long car commutes to obesity, poor cardiovascular health, high blood pressure, self-reported tension, and negative mood in the evening. ¹⁶ Trends that allow commuters to let go of steering wheels each morning and evening, then, could improve health outcomes.

New mobility technologies and patterns could help address some of these challenges. Analysts expect plug-in electric vehicles to reach 10 percent of US light-duty vehicle sales by 2025, and even more rapid adoption afterward could be enabled by falling battery prices, global regulatory changes, and the synergies between electric drivetrains and autonomous vehicle systems.¹⁷

Coupled with better-integrated mobility networks that enable multimodal trips and encourage active forms of transit,¹⁸ the result could be reductions in the chronic health conditions associated with long commutes that rely on internal combustion engines, such as asthma, hypertension, and obesity.

With possibly lower disease incidence due to pollution, health systems should anticipate the potential for a changing mix of patient conditions and care needs, which could affect everything from the number of respiratory specialists needed to investments in oncology. However, as with potentially lower demand for trauma care due to fewer expected accidents, the health system bearing financial

risk for the total cost of care would benefit financially from lower disease incidence.

Expanded patient mobility could improve access to care

Patient no-shows remain a persistent challenge for health systems, with missed appointment rates in many large clinics ranging from 18 percent to more than 30 percent, creating a financial burden and lost efficiency. Access to transportation is often a critical barrier to receiving care, especially for chronic conditions that require regular appointments. As the authors of a recent meta-analysis of the issue observe, Collectively, these studies suggest that lack or inaccessibility of transportation may be associated with less health care utilization, lack of regular medical care, and missed medical appointments, particularly for those from lower economic backgrounds.

In the near term, if ridesharing and carsharing become more prevalent, vulnerable populations such as the elderly, disabled, or those without cars can experience greater access to health care. Mobility companies can collaborate with health plans and providers to offer specialized transportation and improve point-to-point and last-mile shared solutions to allow those living in transportation deserts to access crucial services more easily. In some cases, Medicaid and other insurance plans may even cover such rides. Lyft, for example, has partnered with health insurers to offer non-emergency patient transportation, contributing to decreased wait times and cost-per-trip.²¹ MedStar Health, a non-

Health systems at the forefront of supporting better access through transportation have the potential to not only reduce no-shows but better coordinate care and provide needed services. profit health system in Maryland and the District of Columbia, established a partnership with Uber that allows patients to access ridesharing services through the MedStar website and set reminders for medical appointments. Those lacking access to the Uber smartphone app can call the system's health advocates to arrange transportation.²² (Telemedicine is another approach to help close the gap in administering care, although it presupposes patients' access to and comfort with connected technology, such as computers and broadband Internet.²³)

Combining this trend with the power of autonomous vehicles and connected vehicle infrastructure, health systems or emergent players could create mobile care units that optimize health professional rounds, dispatching physicians, nurses and others to remote care sites or patient homes. No longer designed around the driver's needs, vehicle interiors can use other emergent technologies such as additive manufacturing, augmented reality, and virtual reality to create highly capable autonomous mobile care units that complete tasks that once took place in hospitals, such as 3D printing a custom cast for a broken bone on the spot, running tests on vitals, or holding consultations with specialists. Some design companies have already unveiled autonomous ambulance concepts that would "virtually place an emergency physician on board with the Emergency Medical Technicians (EMTs) and paramedics" and that use analytics to optimize the locations of the entire self-driving fleet throughout the day.24

Health systems at the forefront of supporting better access through transportation have the potential to not only reduce no-shows but better coordinate care and provide needed services. Patient experience would likely improve as well, possibly resulting in higher experience scores and therefore not only higher performance payments but a potentially improved brand in the marketplace.²⁵

Mobility technologies can help optimize the clinical supply chain and procurement

Patients would not be alone in benefiting from the mobility transformations. Medical supply chains can be perilously fragile, as highlighted by the recent nationwide shortage of IV bags after Hurricane Maria damaged a key manufacturing facility in Puerto Rico.²⁶ With increased access to cheaper, faster, and more flexible distribution channels, health care systems would be able to deliver clinical supplies more efficiently and at a lower cost across their provider network.

Distribution networks powered by autonomous vehicles could increase the speed and predictability with which goods move from suppliers to patients or providers. Cognitive technologies paired with real-time analytics can dynamically optimize routes and take advantage of new or underutilized assets throughout the transportation system. Drone technology can help complement the clinical supply chain by providing just-in-time delivery of emergency supplies, such as organs. This could further be enabled by 3D printing capabilities, allowing providers to produce clinical supplies in-house and quickly, reducing the cost and time required to procure high-priority and time-sensitive supplies.²⁷

As clinical supply chain management considers shifting its focus to just-in-time production and delivery, new players could emerge. Amazon, for instance, has begun to lay the real estate groundwork to compete in the \$400 billion pharmacy market with its acquisition of Whole Foods,²⁸ and it already plays a sizable and growing role in medical devices

Companies throughout the medical supply chain should think about how the future of mobility could impact their business models, including the potential unintended consequences. supply.²⁹ The company could leverage its operational expertise to become a significant platform for delivery of medical devices and pharmaceuticals. Shared mobility services, such as Uber Freight, could help fill gaps in the clinical supply chain.³⁰ Firms are already piloting drone delivery of medications and other supplies in remote areas in Africa.³¹ Enterprises with distribution scale and expertise could begin to disrupt the clinical supply chain market by leveraging these efficiencies and taking advantage of on-demand consumer preferences.

Changes in mobility could reduce total cost of care for health systems that work with vendors that leverage these opportunities. And for existing distributors, they risk being disrupted if they do not take advantage of the possibilities. Companies throughout the medical supply chain should think about how the future of mobility could impact their business models, including the potential unintended consequences. For instance, if there are fewer auto accidents due to autonomous vehicles, donor organ supply shortages could be exacerbated; one in five transplant organs are currently harvested from car crash victims.³² Providers should begin looking now toward alternative supply chain solutions, such as 3D bio-printing and other regenerative technologies, to prepare for the eventual reduction.



Building a strategy for health care in the future of mobility

HIS paper suggests four ways in which new mobility patterns could transform health care, but these are likely only the beginning. Many health care organizations—including providers, life sciences companies, and health plans—are feeling the need to respond to margin pressure and the expectation from purchasers and consumers that they deliver better outcomes and consumer experience.

Organizations can start by evaluating the impact of different future mobility states on their current positioning to identify potential vulnerabilities and opportunities. Some may find openings to apply shared mobility and autonomous vehicles to current strengths (for instance, strong physician networks or a trusted brand name) to explore innovative, low-cost models focused on maintaining health instead of treating traumatic injuries. However, this exercise may reveal that organizations need to rethink their strategies in order to remain competitive.

Some organizations have already taken steps related to this, partnering with ridesharing companies to bring patients to appointments, for example. Pilot programs such as these—as well as investments in companies testing new care models—could allow incumbent health care organizations to explore innovative treatment methods while addressing current patients' needs. As organizations consider where to invest, they should work to understand:

- · What populations are we committed to serving?
- How do we communicate the unique value and price premium of our services to both health care consumers and payers versus potentially cheaper and more convenient options?
- How might shifts in mobility change individuals' behaviors as health care consumers, their ability to access care, and their health status?
- What services in our offering are likely to become mobile, devolved to low-cost care sites, or unessential in the future of mobility?

As health care organizations seek to answer these questions and test new care models, focus on the health care consumer, structured approaches to innovation and prototyping, and strong data-driven decision-making would be important. Care delivery solutions should be designed with consideration for autonomous vehicles, shared mobility, and multimodal journeys. If these technologies take hold, the rate of change could be rapid, and organizations positioned for incremental change may be overcome by events before they know it.

ENDNOTES

- 1. Nick Wingfield, Katie Thomas, and Reed Abelson, "Amazon, Berkshire Hathaway and JPMorgan team up to try to disrupt health care," *New York Times*, January 30, 2018.
- 2. Alex Davies, "GM will launch robocars without steering wheels next year," Wired, January 12, 2018.
- 3. Scott Corwin, Nick Jameson, Craig Giffi, and Joe Vitale, *Gearing for change*, Deloitte University Press, September 29, 2016.
- 4. Scott Corwin, Joe Vitale, Eamonn Kelly, and Elizabeth Cathles, *The future of mobility*, Deloitte University Press, September 24, 2015.
- 5. By autonomy and autonomous vehicles, we refer to stage 4 of the National Highway Traffic Safety Administration's scale of autonomy—i.e., full self-driving automation in which the passengers are not expected to take control for the entire duration of travel.
- 6. Corwin et al., *The future of mobility*; Scott Corwin, Nick Jameson, Derek M. Pankratz, and Philipp Willigmann, *The future of mobility: What's next?*, Deloitte University Press, September 14, 2016.
- Centers for Disease Control and Prevention, "National hospital ambulatory medical care survey: 2014 emergency department summary tables," 2014; Centers for Disease Control and Prevention, "Motor vehicle crash injuries," October 2014.
- 8. World Health Organization, "Number of road traffic deaths," accessed February 19, 2018.
- 9. Santokh Singh, "Critical reasons for crashes investigated in the National Motor Vehicle Crash Causation Survey," National Highway Traffic Safety Administration, February 2015.
- 10. Insurance Institute for Highway Safety, "Stay within the lines: Lane departure warning, blind spot detection help drivers avoid trouble," *Status Report* 52, no. 6 (2017).
- 11. Centers for Disease Control and Prevention, "National Hospital Ambulatory Medical Care Survey: 2014 Emergency Department Summary Tables."
- 12. Federico Karagulian et al., "Contributions to cities' ambient particulate matter (PM): A systematic review of local source contributions at global level," *Atmospheric environment* 120 (2015): pp. 475–83.
- 13. World Health Organization, "WHO Global Urban Ambient Air Pollution Database," 2016.
- 14. OECD, The Cost of Air Pollution: Health Impacts of Road Transport (Paris: OECD Publishing, 2014).
- 15. Erik Hansson et al., "Relationship between commuting and health outcomes in a cross-sectional population survey in southern Sweden," *BMC Public Health* 11, no. 1 (2011): p. 834.
- 16. Christine M. Hoehner et al., "Commuting distance, cardiorespiratory fitness, and metabolic risk," *American Journal of Preventive Medicine* 42, no. 6 (2012): pp. 571–78; Glenn Lyons and Kiron Chatterjee, "A human perspective on the daily commute: Costs, benefits and trade-offs," *Transport Reviews* 28, no. 2 (2008): pp. 181–98.
- 17. Scott Smith, Suzanna Sanborn, and Andrew Slaughter, *Powering the future of mobility*, Deloitte University Press, October 16, 2017.
- 18. Deloitte and the World Economic Forum, Designing seamless integrated mobility, January 2018.
- 19. Parviz Kheirkhah et al., "Prevalence, predictors and economic consequences of no-shows," *BMC Health Services Research* 16, no.13 (2016).

- 20. J. Whitehead, John Shaver, and Rob Stephenson, "Outness, stigma, and primary health care utilization among rural LGBT populations," *PLOS one* 11, no. 1 (2016).
- 21. Christina Farr, "Lyft is driving patients to see their doctors and saving insurers big money," CNBC, August 4, 2017.
- 22. Zhai Yun Tan, "Medical providers try Uber, Lyft for patients with few transportation options," *Kaiser Health News*, August 17, 2016.
- 23. Leslie Korenda, Claire Boozer Cruse, and Greg Reh, *Will patients and caregivers embrace technology-enabled health care?*, Deloitte University Press, August 30, 2016.
- 24. Josh Newby, "The future of autonomous emergency response," Frog Design blog, November 2, 2015.
- 25. David Betts, Andreea Balan-Cohen, Maulesh Shukla, and Navneet Kumar, *The value of patient experience*, Deloitte Center for Health Solutions, 2016.
- 26. Stephanie Armour and Thomas M. Burton, "Hospitals wrestle with shortage of IV bags, linked to hurricane," *Wall Street Journal*, January 7, 2018.
- 27. Glenn H. Snyder, Mark Cotteleer, and Ben Kotek, 3D opportunity in medical technology, Deloitte University Press, April 28, 2014.
- 28. Christina Farr, "If Amazon wants to sell prescription drugs, Whole Foods could provide the real estate," CNBC, June 16, 2017.
- 29. Alex Kacik, "Amazon poised to deliver disruption in medical supply industry," Modern Healthcare, June 10, 2017.
- 30. Marco della Cava, "Uber is now in the trucking business: 'press a button, get a load'," USA Today, May 18, 2017.
- 31. Jack Stewart, "Blood-carrying, life-saving drones take off for Tanzania," Wired, August 24, 2017.
- 32. Ian Adams and Anne Hobson, "Selfdriving cars will make organ shortages even worse," Slate, December 30, 2016.

ABOUT THE AUTHORS

RALPH JUDAH

Ralph Judah is a managing director of Monitor Deloitte, with more than 40 years of experience serving clients across the health and wellness industries. He is currently Deloitte's Health Care Strategy leader and serves on the firm's US and Global Leadership team. Judah has broad health insurance, provider, pharmacy, business model transformation, and strategy formulation and implementation expertise.

JOSH LEE

Josh Lee is a principal at Monitor Deloitte and leads the firm's Health Care Provider Strategy practice. He has extensive experience in enterprise and business unit strategy, large-scale transformation, innovation, operations, and organizational strategy. Lee has worked across all areas of the global health care ecosystem, including academic medical centers, for-profit and nonprofit systems, commercial payers, life sciences, public health organizations, and in national/federal health.

ADAM HEWSON

Adam Hewson is a manager within Monitor Deloitte's Health Care Provider Strategy practice, where he specializes in corporate strategy, business unit strategy, and customer growth strategy. His work focuses on building enterprise-wide strategic options and initiatives to support growth and organizational alignment in light of external environmental challenges.

SARAH SLATER

Sarah Slater is a consultant at Deloitte Consulting LLP whose work focuses on building sustainable growth strategies for clients in the health plan, digital health, and health care services sectors. Prior to Deloitte, Slater worked at a venture capital firm in India, conducting due diligence on early-stage companies across industries.

ACKNOWLEDGEMENTS

The authors would like to thank **Mike Caragher** and **Bryan Dextradeur** for their contributions to this article. In addition, **Scott Corwin**, **Sarah Thomas**, and **Derek Pankratz** provided valuable feedback that helped shape our thinking. **Matthew Budman** of Deloitte Insights offered excellent editorial support.

CONTACTS

Ralph Judah

Strategy leader, Plans and Global HCSS Managing director Deloitte Consulting LLP +1 617 584 0455 rajudah@deloitte.com

Josh Lee

Strategy leader, Health Care Provider Principal Deloitte Consulting LLP +1 617 437 3891 joshlee@deloitte.com

Scott Corwin

Future of Mobility practice leader Managing director Deloitte Consulting LLP + 1 917 853 3735 scottcorwin@deloitte.com

ABOUT DELOITTE'S CENTER FOR INTEGRATED RESEARCH

Deloitte's Center for Integrated Research focuses on critical business issues that cut across industry and function, from the rapid change of emerging technologies to the consistent factor of human behavior. We uncover deep, rigorously justified insights, delivered to a wide audience in a variety of formats, such as research articles, short videos, or in-person workshops.



Sign up for Deloitte Insights updates at www.deloitte.com/insights.



Follow @DeloitteInsight

Deloitte Insights contributors

Editorial: Matthew Budman and Abrar Khan **Creative:** Kevin Weier and Mahima Dinesh

Promotion: Devon Mychal **Artwork:** Traci Daberko

About Deloitte Insights

Deloitte Insights publishes original articles, reports and periodicals that provide insights for businesses, the public sector and NGOs. Our goal is to draw upon research and experience from throughout our professional services organization, and that of coauthors in academia and business, to advance the conversation on a broad spectrum of topics of interest to executives and government leaders.

Deloitte Insights is an imprint of Deloitte Development LLC.

About this publication

This publication contains general information only, and none of Deloitte Touche Tohmatsu Limited, its member firms, or its and their affiliates are, by means of this publication, rendering accounting, business, financial, investment, legal, tax, or other professional advice or services. This publication is not a substitute for such professional advice or services, nor should it be used as a basis for any decision or action that may affect your finances or your business. Before making any decision or taking any action that may affect your finances or your business, you should consult a qualified professional adviser.

None of Deloitte Touche Tohmatsu Limited, its member firms, or its and their respective affiliates shall be responsible for any loss whatsoever sustained by any person who relies on this publication.

About Deloitte

Deloitte refers to one or more of Deloitte Touche Tohmatsu Limited, a UK private company limited by guarantee ("DTTL"), its network of member firms, and their related entities. DTTL and each of its member firms are legally separate and independent entities. DTTL (also referred to as "Deloitte Global") does not provide services to clients. In the United States, Deloitte refers to one or more of the US member firms of DTTL, their related entities that operate using the "Deloitte" name in the United States and their respective affiliates. Certain services may not be available to attest clients under the rules and regulations of public accounting. Please see www.deloitte.com/about to learn more about our global network of member firms.

Copyright © 2018 Deloitte Development LLC. All rights reserved. Member of Deloitte Touche Tohmatsu Limited