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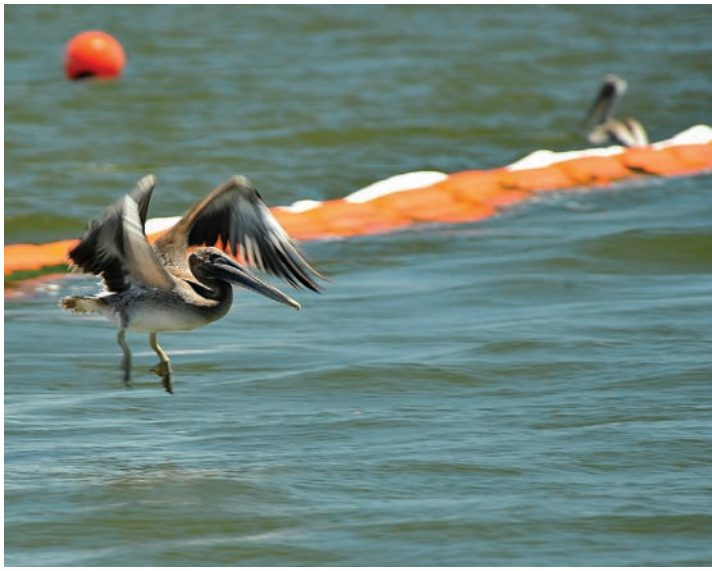

Combating Falsified and Flawed Drugs

New Gulf of Mexico Research Program

Helping Vets Readjust to Civilian Life

Potential for Alternative Vehicles and Fuels

Summer 2013
vol. 13 number 1

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

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While many of our studies are funded by agencies of the federal government and Congress, private donations from individuals, foundations, and corporations allow us to take on many other vital projects and initiatives.

Take the training of young scientists, engineers, and health professionals in national and international policymaking, for example. Graduate coursework in science, technology, or medicine generally offers students few insights into the role science plays in shaping sound public policy. Through our Christine Mirzayan Science and Technology Policy Graduate Fellowship Program, now in its 16th year, highly qualified students and early career professionals come to the nation's capital to learn how science influences policy and gain firsthand experience by working on studies and activities here at the Academies. That engagement often sparks careers in public service: Alumni have gone on to work for congressional committees, at federal agencies such as the U.S. Department of State, National Institutes of Health, and the National Science Foundation, and at international institutions such as the European Union and World Bank.

In 2014 these fellowships will continue, thanks to generous support from our presidents and from former NAS President Bruce Alberts. "It's terrific that these fellowships will continue," Alberts said. "They have helped many talented professionals build effective careers in science, technology, and health policy, and these are precisely the types of people that the world urgently needs to spread scientific thinking throughout society." Funding is also being provided by the Burroughs Wellcome Fund, a private foundation dedicated to supporting research and other scientific and educational activities; Sara Lee Schupf; and alumni of the fellowship program.

Another example is the Ford Foundation Fellowship Program, launched 51 years ago to build a more equitable higher education system and increase the diversity of the nation's college and university faculties. Recently, the foundation boosted its commitment to the program, pledging $100 million over the next decade. Administered by the National Research Council, these fellowships are awarded to deserving young scholars who are committed to careers in academia. To date, at least 14 Ford fellows have become university presidents or provosts.

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Icons of the American West

REPORT OFFERS SCIENCE-BASED STRATEGIES FOR MANAGING WILD HORSES AND BURROS

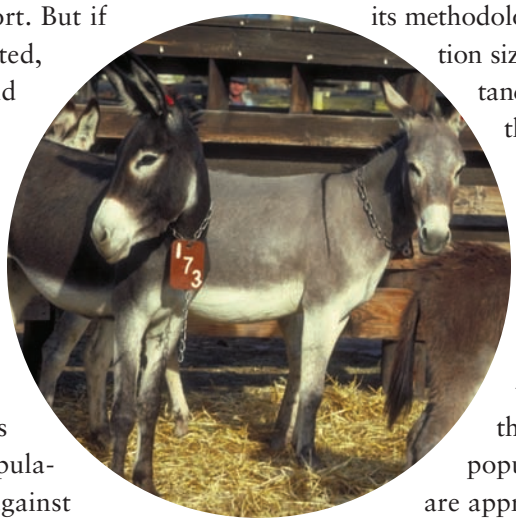
Wild horses are synonymous with the spirit of the American West. Just mentioning them conjures images of these animals running across the open range with their manes blowing in the wind. Although these images are iconic, the reality is that more wild horses may end up in long-term holding facilities than roaming western lands.

Federal protection and management of wild horses on western public lands began with the Wild Free-Roaming Horses and Burros Act of 1971. But now, decades later, the program is in crisis. In order to sustain healthy horse and burro populations at appropriate levels and maintain ecological balance on public lands, the U.S. Bureau of Land Management removes horses from the range and tries to place them in private homes through adoption. The challenge is that the number of animals rounded up now greatly exceeds the adoption demand, and costs for holding and caring for unadopted animals consumes about half the budget for BLM's Wild Horse and Burro Program, which aims to protect, manage, and control wild horses and burros to ensure healthy herds on flourishing rangelands. The current practice of periodically removing a portion of the animals and keeping them in holding facilities is economically unsustainable and doesn't meet public expectations.

In addition, the animals on the range are increasing at a rate of 15 percent to 20 percent a year, meaning these populations will double in four years and triple in six years. Faced with these constraints, BLM asked the National Research Council to examine the scientific basis of its management practices. The report outlines the tools that exist for BLM to better manage the animals on healthy lands, enhance public

engagement and confidence, and make the program more financially sustainable.

BLM's current removal strategy enables the high population growth rate by maintaining the number of animals below the capacity of the land, found the committee that wrote the report. But if removals were eliminated, land degradation would likely occur, leading to inadequate food and water supplies and higher death rates. Periodic droughts may cause sudden and unpredicted impacts as well. Allowing these impacts on either the horse population or the land goes against the program's mission.



"Continuing to remove the horses and placing them in holding facilities is not a long-term solution and will only become more expensive," said committee chair Guy Palmer. "BLM should explore other ways to slow the growth rate so the number of horses removed is in line with the number of animals adopted."

To help control the horse population, the committee recommended widespread and consistent application of fertility control. Three methods in particular — porcine zone pellucida (PZP) and GonaConTM for mares and chemical vasectomy for stallions — were identified as effective approaches.

"These fertility methods are recommended based on their efficacy with other horse populations, notably those on Assateague Island," Palmer said. "Nevertheless, scaling up use of these approaches to the larger and more dispersed horse populations in the western U.S. will be challenging."

The report also says that BLM's population surveys likely miss 10 percent to 50 percent of the animals. The committee recommended that BLM improve and standardize its methodology to estimate population size, stressing the importance of accurate counts as the basis for all management strategies.

BLM should also examine the genetics and health of the horses as well as the rangelands they occupy to assure that both the animal populations and ecosystem are appropriately managed.

Moreover, developing an iterative process whereby members of the public could engage with BLM scientists on data gathering and assessment would increase the transparency, quality, and acceptance of BLM's process, concluded the committee.

— *Jennifer Walsh & Lorin Hancock*

Using Science to Improve the BLM Wild Horse and Burro Program: A Way Forward. Committee to Review the Bureau of Land Management Wild Horse and Burro Management Program, Board on Agriculture and Natural Resources, Division on Earth and Life Studies (2013, 630 pp.; ISBN 978-0-309-26494-5; available from the National Academies Press, tel. 1-800-624-6242; $74.00 plus $5.00 shipping for single copies; also on the Internet at <www.nap.edu/catalog/13511.html>).

The study was chaired by **Guy Palmer,** regent professor of pathology and infectious diseases, the Jan and Jack Creighton Endowed Chair in Global Health, and director of the Paul G. Allen School for Global Animal Health, Washington State University, Pullman. The study was sponsored by the U.S. Bureau of Land Management.

NAS LAUNCHES NEW RESEARCH PROGRAM ON GULF OF MEXICO

The impacts of the 2010 Deepwater Horizon explosion and oil spill, which killed 11 people and released approximately 200 millions of oil into the Gulf of Mexico, will likely be felt for decades along the Gulf coast. The spill damaged more than 1,000 miles of coastal wetland and harmed the health and productivity of the region's many natural resources, impacting the communities that rely on them.

The broad nature of the spill's effects has prompted the creation of a long-term research program that will seek ways to minimize the damage and advance understanding of health, environment, and oil system safety in the Gulf of Mexico and other outer continental shelf regions. As part of the settlement between the companies involved and the U.S. government, penalty payments totaling $500 million are being used to establish a new 30-year program administered by the National Academy of Sciences that will research ways to protect human health and the environment in the Gulf region. The program will also look at ways to make offshore drilling safer in the Gulf and along the United States' outer continental shelf.

"Given the wide breadth of this research and the timeframe for the new program, we need to be sure we think big," said NAS President Ralph Cicerone in a video statement about the program. "We also need to consider how to balance the need for near-term results with long-term objectives."

The program will be a joint effort of the NAS, National Academy of Engineering, Institute of Medicine, and National Research Council. A strategic planning phase is under way to ensure that the program targets activities that use the Academies' strengths and complement other efforts already taking place in the Gulf.

The planning process is being led by an advisory group made up of experts with experience in academia and industry, as well as people with deep connections to the Gulf region. The group, chaired by former NAS Vice President Barbara Schaal, held its first meeting in New Orleans in late July. In coming months it will hold several more meetings, most along the Gulf, to help identify issues the program should address and to build relationships with stakeholders. — *Sara Frueh*

More information on the Gulf program can be found at <www.nationalacademies.org/gulf/gulfprogram.html>.

Earth-Friendly Vehicles and Fuels

WHAT WILL IT TAKE FOR AMERICANS TO BUY INTO ALTERNATIVES?

By 2050, it may be possible for the U.S. to reduce the petroleum use and greenhouse gas emissions of light-duty vehicles to less than 20 percent of what they are today, according to a recent report by the National Research Council. We could see a fleet of highly efficient conventional vehicles mixed with vehicles running on electricity, biofuels, and/or hydrogen. The big question is whether American consumers will be willing to make the transition from the cars and light trucks that they love to unfamiliar yet more efficient vehicles.

The chief concern to individual drivers will likely be cost, said the committee that wrote the report. The efficient vehicles of the future will be several thousand dollars more expensive than today's conventional vehicles. While driving costs per mile will be lower, a high price tag might be a significant barrier to widespread acceptance.

Consumers are also accustomed to personal vehicles that come in a wide variety

of sizes, styles, and prices, tailored to match unique needs and personalities. In the early years, alternative vehicles will be limited to a few body styles and sizes; some will require bulky energy storage that will reduce their cargo and passenger room, and others will have a restricted travel range or rely on fuels that are not readily available.

If the 2050 goals can be achieved, though, the societal benefits in transitioning to alternative vehicles and fuels would be tremendous — especially for climate change and energy security, the report says. The barriers should be surmountable if there is a national commitment to make major reductions in greenhouse gas emissions and oil use.

Government policy actions will be necessary to meet the goals, the committee said, possibly combining several strategies: high and increasing fuel economy standards, more stringent than the 2025 standards; higher petroleum taxes; subsidies; or "feebates," an approximately revenue-neutral program wherein owners of less-efficient vehicles pay a fee and owners of more efficient vehicles earn a rebate. Public information campaigns will play a key role, so that consumers have an understanding of new fuels and powertrains.

It is essential that policies promoting particular technologies to the public are not introduced before these new fuels and vehicle technologies are close to market readiness and consumer behavior toward them is well-understood. The report identifies clear tipping points at which consumers will transition to new vehicle technologies en masse. If policies are insufficient to overcome the early cost differentials, then the transition to such technologies will not occur. Technologies should only be forced into the market when their benefits justify the costs.

Strong government intervention would need the support of lawmakers and the American public to succeed. However, if we aren't ready to make that commitment as a nation, there are still opportunities to come close to the 2050 goals, the report says. For example, traditional internal combustion engine vehicles could become much more efficient by reducing work the engine must perform — lowering vehicle weight, aerodynamic resistance, rolling resistance, and accessories — plus improving the efficiency of the internal combustion engine powertrain. Making conventional vehicles more efficient is, up to a point, the most economical and easiest-to-implement approach to saving fuel and lowering emissions. While this alone will not meet the 2050 goals, it would definitely be a good start. — *Lorin Hancock*

Transitions to Alternative Vehicles and Fuels. Committee on Transitions to Alternative Vehicles and Fuels, Board on Energy and Environmental Systems, Division on Engineering and Physical Sciences (2013, 170 pp.; ISBN 978-0-309-26852-3; available from National Academies Press, tel. 1-800-624-6242; $59.00 plus $5.00 shipping for single copies; also on the Internet at <www.nap.edu/catalog/18264.html>).

The study was chaired by **Douglas Chapin,** principal of MPR Associates Inc., Alexandria, Va. The study was funded by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy.

DILUTED BITUMEN

A Crude Oil Like Any Other?

Diluted bitumen is a substance that is often referred to by many names — dilbit, synbit, tar sands oil. Although it has traveled through pipelines in the U.S. for more than 30 years, few people outside the oil industry had heard of it until recently.

Diluted bitumen is a type of heavy crude oil that is imported from the oil sands region of western Canada. As the name indicates, the substance consists of bitumen — a dense and viscous form of petroleum — diluted with lighter oils so it can flow through pipelines. Diluted bitumen is transported through the existing Keystone Pipeline System, and would also be transported through its proposed expansion, the Keystone XL pipeline.

With diluted bitumen imports on the rise, Congress passed legislation in January 2012 calling upon the secretary of transportation to determine whether transporting this heavy crude increases the risk of a pipeline release. The U.S. Department of Transportation asked the National Research Council to convene an expert committee to analyze one aspect of the risk: whether pipelines transporting diluted bitumen have a greater likelihood of accidental release when compared with pipelines transporting other crude oils. The committee was not asked to assess whether the consequences of a diluted bitumen release differ from those of other crude oil releases.

After thorough research of incident statistics, data on the chemical and physical properties, and consultations with experts in pipeline operations and failure mechanisms, the Research Council committee concluded that transporting diluted bitumen through pipelines does not increase the likelihood of release. The study committee took into account many possibilities — from internal corrosion to operator error to extremes in operating pressures and temperatures — and found no aspect of diluted bitumen's transport by pipeline makes it more likely than other crude oils to cause an accidental release.

Diluted bitumen does not have physical or chemical properties that are outside the range of other crude oils. Shipments of this substance do not differ from other crudes in flow rate, pressure, or operating temperature. And there is no evidence that pipeline operators manage or maintain their systems any differently when transporting diluted bitumen. In short, diluted bitumen behaves in the pipeline just like other similar crude oils, the committee found.

Though this specific question has been answered, it appears this once obscure form of crude oil will continue to draw attention and is set to remain in the spotlight for the foreseeable future. — *Lorin Hancock*

Effects of Diluted Bitumen on Crude Oil Transmission Pipelines: TRB Special Report 311. Committee for a Study of Pipeline Transportation of Diluted Bitumen; Transportation Research Board; Board on Chemical Sciences and Technology, Division on Earth and Life Studies; Board on Energy and Environmental Systems, Division on Engineering and Physical Sciences (2013, approx. 112 pp.; ISBN 978-0-309-28675-6; available from National Academies Press, tel. 1-800-624-6242; also on the Internet at <www.nap.edu/catalog/18381.html>).

Mark Barteau, DTE Energy Professor of Advanced Energy Research, and director of the Energy Institute, University of Michigan, Ann Arbor, chaired the committee. The study was funded by the Pipeline and Hazardous Materials Safety Administration of the U.S. Department of Transportation.

War's Aftermath

EASING THE RETURN TO CIVILIAN LIFE

More than 2.2 million U.S. troops have served in the wars in Iraq and Afghanistan, which have claimed 6,600 American lives and resulted in more than 48,000 injuries. War's consequences also reach beyond the immediate and physical, reverberating through the lives of soldiers, families, and communities long after those who have served return home.

Although many veterans of the recent wars have transitioned back to civilian life with few difficulties, a large minority have struggled. Forty-four percent of veterans of the Iraq and Afghanistan wars report difficulty readjusting to civilian life, 48 percent have experienced strains in family life, and 47 percent report outbursts of anger. Such difficulties are sometimes exacerbated by lingering war-related health problems, such as traumatic brain injuries and post-traumatic stress disorder (PTSD).

How can the departments of Defense and Veterans Affairs help these soldiers readjust, along with their families and communities? At the request of Congress, the Institute of Medicine conducted a study

to advise these agencies on how to meet the needs of this growing group of veterans.

Currently, the approaches DOD and VA use to screen and treat veterans for brain injuries and psychological health problems are not always solidly supported by evidence, IOM's report concludes. The tool DOD uses to assess cognitive function after a head injury, for example, lacks clear evidence of effectiveness. On the other hand, research shows that restricting access to lethal means effectively reduces suicides, but DOD policy prohibits restricting access to privately owned weapons for those at risk. The IOM study committee also expressed concern at the low rates of delivery of certain evidence-based treatments, such as psychotherapies to treat PTSD and depression and approved medications for substance use disorder.

While most health consequences of service are linked to the inherently dangerous nature of war, many female service members face lingering emotional and physical effects from traumas unrelated to combat: sexual assaults and harassment, which studies show are occurring at high rates in the military, including during the wars in Iraq and Afghanistan. DOD should intensify its efforts to eliminate assault and harassment, and should add criteria to commanding officers' performance reviews that assess how well they deal with these problems, the report says.

DOD has many programs and policies to support veterans' families, who often face hardships during and after deployments, ranging from economic and health burdens to domestic violence. But these programs typically do not consider all types of families, focusing almost exclusively on married, heterosexual couples and their children. The agency should ensure that its policies, programs, and practices aim to support a full range of military families, which increasingly include unmarried partners, same-sex couples, single parents, and stepfamilies.

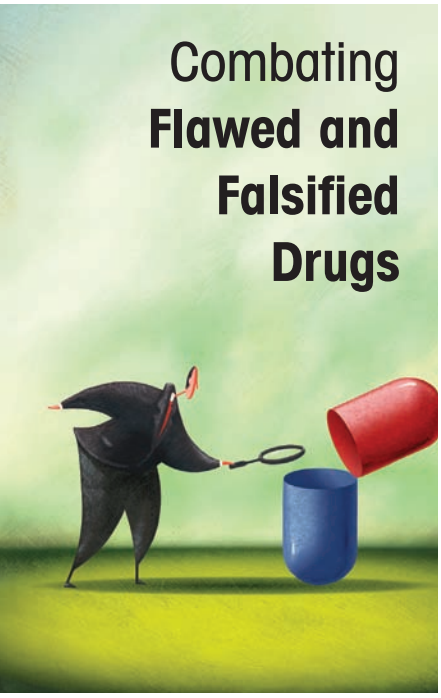
Unemployment and underemployment, problems currently faced by many American citizens, are even more acute for veterans, especially young ones, the report says. Among post 9/11 veterans ages 18 to 24, the unemployment rate was almost twice as high as among their civilian peers — 30.2 percent compared with 16.1 percent. DOD should evaluate its programs to assist veterans in transitioning to the civilian work force. Identifying those that are most effective will allow scarce resources to be targeted appropriately.

DOD and VA should also conduct forecasts of the amount and types of resources that will be needed to support Iraq and Afghanistan veterans over the next 30 years or more, the report says. Previous wars have shown that veterans' needs peak several decades after the war in which they served. — *Sara Frueh & Christine Stencel*

Returning Home From Iraq and Afghanistan: Assessment of Readjustment Needs of Veterans, Service Members, and Their Families. Committee on the Assessment of Readjustment Needs of Military Personnel, Veterans, and Their Families; Board on the Health of Select Populations; Institute of Medicine (2013, 794 pp.; ISBN 978-0-309-26427-3; available from National Academies Press, tel. 1-800-624-6242; $72.00 plus $5.00 shipping for single copies; also on the Internet at <www.nap.edu/catalog/13499.html>).

The study committee was chaired by **George W. Rutherford,** Salvatore Pablo Lucia Professor and vice chair, department of epidemiology and biostatistics, and director, prevention and public health group, Global Health Sciences, University of California, San Francisco. The study was funded by the U.S. Department of Defense.

A Weak Link in the Drug Supply Chain



In 2011 and 2012 fake versions of the cancer drug Avastin reached the U.S. market, only one instance of a problem that is global in scope: falsified and substandard medications. Some of these drugs contain little or no active ingredient — the case with the falsified Avastin — and fail to heal patients, prolonging suffering and driving up the cost of care. Others contain toxic ingredients that actively sicken and kill; in 2008 and 2009, for example, 84 Nigerian children died from kidney failure caused by an industrial solvent, diethylene glycol, in teething syrup. Often the effects of inactive or toxic drugs can go unnoticed or be mistaken for the underlying disease, especially in parts of the world with weak oversight systems and generally high mortality rates.

The Institute of Medicine was asked by the U.S. Food and Drug Administration to examine the problem and recommend ways to help solve it. Falsified and substandard drugs are a difficult problem in part because medications make their way through complex channels of primary and secondary wholesalers and retailers. Every step affords opportunities for fake or poor-quality products to enter the market.

Secondary wholesalers — who buy medications from other wholesalers rather than directly from manufacturers — are the weakest link in the chain, the report says. These firms may trade in many products besides pharmaceuticals, and their staff are not required to show skill in managing or warehousing pharmaceuticals. All state licensing boards should license only wholesalers and distributors that meet the accreditation standards of the National Association of Boards of Pharmacy (NABP). States should collaborate with FDA to create a public database where states should report violations and license suspensions. And Congress should authorize and provide funds for FDA to establish a mandatory track-and-trace system that gives each package of medication a unique identifier, allowing it to be followed through every transaction.

The problem of falsified and substandard drugs will not be solved solely by countries acting individually, however. The report recommends that the World Health Organization lead an effort to develop a code of practice that includes guidelines on surveillance, regulation, and law enforcement. Similar codes on the marketing of breast milk substitutes have been effective.

One area of the industry — online pharmacies — will be difficult to regulate, the report says. It praises NABP's Verified Internet Pharmacy Practice Sites, an accreditation program for online pharmacies, as a useful program to help consumers identify legitimate pharmacies.

— *Sara Frueh & Christine Stencel*

Countering the Problem of Falsified and Substandard Drugs. Committee on Understanding the Global Public Health Implications of Substandard, Falsified, and Counterfeit Medical Products; Board on Global Health; Institute of Medicine (2013, 351 pp.; ISBN 978-0-309-26939-1; available from National Academies Press, tel. 1-800-624-6242; $74.00 plus $5.00 shipping for single copies; also on the Internet at <www.nap.edu/catalog/18272.html>).

The study committee was chaired by **Lawrence O. Gostin,** Linda and Timothy O'Neill Professor of Global Health Law, and director, WHO Collaborating Center on Public Health Law and Human Rights, Georgetown University Law Center, Washington, D.C. The study was funded by the U.S. Food and Drug Administration.

Beginning at birth, Americans fall short when it comes to health. They die sooner, suffer from more disease and illness, and experience more injuries throughout life than people in other rich, industrialized nations. This is all despite the fact that the United States spends more per capita on health care than any other country in the world.

AMERICA'S **HEALTH** DISADVANTAGE

A joint panel of the National Research Council and Institute of Medicine investigated the health and health-related behaviors of people in the U.S. along with those in 16 comparable nations, including Canada, Japan, Australia, and much of Western Europe. They found that the U.S. lands at or near the bottom in nine key areas of health: infant mortality and low birth weight; injuries and homicides; teenage pregnancies and sexually transmitted infections; prevalence of HIV and AIDS; drug-related deaths; obesity and diabetes; heart disease; chronic lung disease; and disability. What's more, the U.S. was found to have the second lowest female life expectancy among the countries in the study; for men, the U.S. ranked last.

Many of the conditions that ail Americans disproportionately affect infants, children, and adolescents, according to the panel's report. Infant mortality rates are higher in the U.S. than in any other high-income country, and have been for decades. Children in the U.S. are also more likely to

die before the age of 5. Among teenagers, pregnancies, sexually transmitted infections, and deaths due to traffic accidents and homicide all occur at higher rates. Deaths before age 50 play a significant role in the overall life expectancy for both men and women.

But there are areas in which the U.S. outperforms many other nations. The study found that elderly adults in the U.S. who live to age 75 actually have longer life expectancies than their international peers. The U.S. also tops the rankings with lower rates of smoking, better control of blood pressure and cholesterol levels, and higher rates of recovery from stroke and cancer.

The broad spectrum of health outcomes makes it hard to pinpoint the root of the problem. Even a flawed health care system can't be held accountable for traffic accidents or homicides, and the considerable percentage of Americans who don't have health insurance can't explain the prevalence of drug use or sexually transmitted infections. Nor can the health disadvantage be blamed solely on the health of the poor or minority groups. The report notes that even when the numbers are adjusted to reflect only those who are insured, well-educated, and practice healthy behaviors, Americans still fall behind.

The panel dug deeper and explored whether America's poor health outcomes could be traced to social or economic factors. Although Americans have higher average incomes, the U.S. has higher levels of poverty and income inequality and lower rates of social mobility. Other countries have surpassed the U.S. in the education of young people. U.S. communities are built in ways that encourage automobile transportation or discourage physical activity. Many of these factors — especially when present in childhood — can shape health trajectories over the entire life course.

It's safe to say that there is no single cause of America's health disadvantage. Individual behaviors, deficiencies in the health care system, adverse social and economic conditions, physical environments, and the public policies that influence all of these factors combine in ways that contribute to overall worse health.

Similarly, individual, social, and political factors may combine in ways that contribute to good health in other nations. The report suggests taking a closer look at the policies and practices that lead to better health outcomes in other countries and how they could inform solutions for the U.S.
— *Lauren Rugani*

U.S. Health in International Perspective: Shorter Lives, Poorer Health. Panel on Understanding Cross-National Health Differences Among High-Income Countries; Committee on Population, Division of Behavioral and Social Sciences and Education; Board on Population Health and Public Health Practice, Institute of Medicine (2013, 420 pp.; ISBN 978-0-309-26414-6; available from National Academies Press, tel. 1-800-624-6242; $72.00 plus $5.00 shipping for single copies; also on the Internet at <www.nap.edu/catalog/13497.html>).

The panel was chaired by **Steven H. Woolf,** professor of family medicine at Virginia Commonwealth University in Richmond. The study was funded by the National Institutes of Health and the U.S. Department of Health and Human Services.

MINE Safety

IMPROVING MINERS' ABILITY TO ESCAPE FROM DISASTERS

Recent disasters at West Virginia's Sago and Upper Big Branch mines are vivid reminders of the inherent dangers of working in underground coal mines. In 2006, Congress enacted the Mine Improvement and New Emergency Response Act, which strengthened mine safety regulations and introduced new measures for improving emergency preparedness and response. Since then, the mining industry has spent $1 billion on emergency preparations.

Improvement in mine safety — especially through regulation — often comes after a major disaster and is designed to mitigate causes of particular incidents. Equally important in overall safety is preparing individual miners with the necessary knowledge, tools, and skills to successfully escape from any emergency situation. Outlining these requirements was the focus of a recent National Research Council report.

Successful escape is not a solo effort but requires a proactive, coordinated approach. The report recommends what is called a human-systems integration approach that incorporates training, technology, equipment, and emergency response plans to establish unified, efficient, and effective protocols that empower self-escape in a mine emergency.

Vast variability in the underground coal mining industry, such as the size of the mine, number of workers, or mining conditions, makes it difficult to ascribe a single best method to managing mine safety. Mine operators should help their workers learn to recognize or respond to warning signals as well as become aware of the specific hazards, exits, and resources where they work. The report recommends that at least annually, in conjunction with one of the required quarterly escape drills, mine operators should conduct a comprehensive self-escape scenario exercise at every underground mine.

In the event of an emergency, a breathable air supply is key for self-escape. Emergency air supply equipment in underground coal mines must function properly in oxygen deficient atmospheres and protect against all harmful gases. Equipment designers should consider optimal size and weight of devices, whether and how air supplies should be changed over or replenished, and miners' ability communicate verbally and see adequately.

Miners should also have a working knowledge of their surroundings and equipment to effectively remove themselves and others to a safe place, as well as have the psychological skills to make decisions and communicate effectively — abilities that can be compromised under stress.

Safety should be a core value in all aspects of mine operation, organization, and training. The report urges mine operators and industry regulators to pursue efforts that create a strong, positive culture of safety. — *Lauren Rugani*

Improving Self-Escape From Underground Coal Mines. Committee on Mine Safety: Essential Components of Self-Escape, Board on Human-Systems Integration, Division of Behavioral and Social Sciences and Education (2013, 167 pp.; ISBN 978-0-309-28276-5; available from National Academies Press, tel. 1-800-624-6242; $45.00 plus $5.00 shipping for single copies; also on the Internet at <www.nap.edu/catalog/18300.html>).

The committee was chaired by **William S. Marras,** professor of engineering at Ohio State University. The study was funded by the National Institute for Occupational Safety and Health's Office of Mine Safety and Health Research.

Obama Speaks at NAS Annual Meeting

President Barack Obama spoke to academy members at the 2013 National Academy of Sciences annual meeting to celebrate the institution's 150th anniversary, becoming only the second president to address the members of the National Academy of Sciences twice. "It's good to be back," he told the packed auditorium, alluding to his visit in 2009.

In opening, the president recounted the story of the Academy's founding during the Civil War and its inaugural task of correcting the compasses on the Union's ironclad ships. But the institution was founded with a mandate far broader than the science of war, he noted. "Even as the nation was at war with itself, President Lincoln had the wisdom to look forward, and he recognized that finding a way to harness the highest caliber scientific advice for the government would serve a whole range of long-term goals for the nation." He pointed to issues on which his own administration had turned to the

Academy for advice, including research priorities, nanotechnology, and the causes of gun violence.

President Obama also stressed the need to invest in research and innovation despite current budget challenges. "We can't let other countries win the race for ideas and technology of the future," not just out of nationalistic pride but also "because nobody does it better than we do when it's adequately funded…and what we do here ends up having benefits worldwide." Protecting the integrity of the scientific process is important as well, he said. "In all sciences, we've got to make sure that we are supporting the idea that they're not subject to politics, that they're not skewed by an agenda, that, as I said before, we go where the evidence leads us."

The nation needs to support the next generation of scientists, Obama said, noting the ambitious challenges taken on by young people who had entered the White House Science Fair. One student had developed a fast, inexpensive test for cancer, for example, while another had developed a way to convert algae into sustainable biofuels. He remarked how these students "shared this fundamental optimism that if you figured this stuff out, people's lives would be better; that there were no inherent barriers to us solving the big problems that we face as long as we were diligent and focused and observant and curious."

In closing, the president thanked the Academy on behalf of the American people and urged the institution to continue to play a central role in informing policy. "I'm absolutely convinced that if this Academy and the successors who become members of this Academy are there at

the center and heart of our public debate, that we'll be able to continue to use the innovation that powers our economy and improves our health, protects our environment and security, that makes us the envy of the world."

In introductory remarks, NAS President Ralph J. Cicerone said, "Like President Lincoln 150 years ago, President Obama clearly understands the importance of S&T to the future prosperity and security of our nation. We're pleased that President Obama and the administration continue to turn to the National Academy of Sciences for help, analysis, and advice on many issues facing the country and the world today."

— Sara Frueh & Molly Galvin

A video of the address can be viewed online at <www.nasonline.org/about-nas/events/presidential-address-2013.html>.

Global Grand Challenges Summit

The first Global Grand Challenges Summit (GGCS) — a two-day event co-hosted by the National Academy of Engineering and the engineering academies of the United Kingdom and China — took place last March in London, where more than 400 people participated with

the purpose of identifying opportunities for global cooperation on engineering innovation and education to address common technological goals.

Also in attendance were 60 college students from around the globe who were invited to attend Student Day just before the GGCS. The students were asked to choose from six of the NAE's Grand Challenges for Engineering and develop a pitch for how to address it. Each team presented its proposal before a panel of expert judges including Microsoft's Tony Hey and Margaret Anne Craig from Clyde Biosciences. The winner, TeleHealth Express, was showcased at the summit, and team's presentation on streamlining health care was well-received. I had the chance to sit in during Student Day and observe the young engineers in their working groups. It was amazing that these students, most of whom had just met for the first time, could come up with realistic ideas for helping address some of the world's greatest challenges within a few short hours. Not only that, they prepared well-conceived, creative business models for bringing their ideas to fruition.

The panel sessions at the summit itself focused on six key themes: sustainability, health, education, technology and growth, enriching life, and resilience. Summit speakers included Caltech's Frances Arnold, Imperial College professor Ara Darzi, former DARPA head and

present Google/Motorola exec Regina Dugan, Stanford University president John Hennessy, prolific inventor Dean Kamen, and economist Jeffrey Sachs, among others. While all of the speakers brought different expertise to the table, it was evident that each was intent on making improvements to the world's future in a drastic way. Once I got past being star-struck, I was blown away by the groundbreaking and unique research these people were doing. For example, fashion and science innovator Helen Storey talked about clothing she's helping to design that purifies air, while Robert Matheson explained how the NAE Grand Challenges for Engineering are being incorporated into curriculum at his school, the new Wake North Carolina State University STEM Early College High School, and Chief Creative Officer of Applied Minds Bran Ferren told of the sobering implications of failing to secure cyberspace.

Additional highlights included plenary addresses from genome pioneer J. Craig Venter and Microsoft Chairman Bill Gates, presentation of the Global Grand Challenges Video Contest winners by NASA's Charles Elachi and entertainer Will.i.am, and announcement of the new

Vest Scholarships, established in honor of NAE President Charles M. Vest to encourage international student collaboration on the NAE Grand Challenges. A new joint project between the U.S. National Science Foundation and the U.K. Engineering and Physical Sciences Research Council to fund trans-Atlantic research with the goal of providing all people with access to clean water was also inspired by the summit.

The summit was full of exciting moments, especially with provocative statements by the speakers. Venter stated that with the help of synthetically engineered molecules "Mars will be colonized within two decades," and Gates, who talked about the importance of improving the quality of life in impoverished countries, argued that "more money is invested into researching male baldness than helping the developing world." A popular and reoccurring motto during the event was "Science needs to be sexier"; Will.i.am advocated that if society gives engineers the attention they deserve and treats them like today's pop and athletic stars, more children will be inspired to enter the field.

The next Global Grand Challenges Summit is set to take place in Beijing, China, in 2015. — *Nicole Flores, program associate for public relations at NAE*

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