PIECING IT TOGETHER
Completing the Picture of Healthcare

BIOME BODY
The importance of symbiosis within the human body

PHYSICIAN BURNOUT
The impact of socialization on modern healthcare structure

LIFE EXPECTANCY AND INCOME GAP
Comparing Philadelphia and New York neighborhoods

THE RISE OF CAPTAGON
How drug addiction took over the Islamic State
Dear Readers,

The relationship between modern medicine and personalization is one that traverses one’s very sense of identity. Medicine has shifted towards targeting granular levels of our core architecture to understand healthcare’s problems. With the advent of innovative technologies, research, healthcare policy, and business ventures, the industry is finally beginning to piece together the fragments that form one’s complete health.

SYNAPSE reaches beyond the layer of traditional healthcare and into the complex web of integrated medicine, captured by our theme of “Piecing it Together: The Picture of Healthcare”. Our feature articles uncover the different, yet equally critical, realms of healthcare. We illuminate the rise of vigorous drugs that threaten the stability of an entire region. We explore the relationship between life expectancy and income gap, to better understand the socioeconomic impact on health. We analyze the growing phenomenon of physician burnout, and how it threatens to push providers over the edge. Regardless of focus, all of our articles seek to piece together the constantly morphing frontiers that form our most important health issues.

In the fifteenth installment of SYNAPSE, we would like to sincerely thank all our members, and each and every member of our Editorial, Design & Layout, and Business teams for their contribution this semester and over their collegiate careers. Without the dedication and hard work of our team, this issue would not have been possible.

Ajay Patel and Celena Chen
Editors-in-Chief
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**ON THE COVER**

This issue’s cover art was designed by Victoria Siu, an undergraduate majoring in Biological Basis of Behavior and minoring in Creative Writing. Through the puzzle iconography, the image represents the ongoing quest for integrating the many facets of healthcare.

Interested in SYNAPSE? Visit www.upennsynapse.com or email edit.synapse@gmail.com for more information.
Imagine pricking your finger for blood six times a day to measure your blood glucose levels, constantly pumping insulin into your body, and constantly being at risk for life-threateningly high or low glucose levels. This is Type 1 Diabetes (T1D), an autoimmune disease that has no prevention or cure, and it is on the rise.⁹

This chronic disease is linked to genetic predisposition and has always been seen as unrelated to diet or lifestyle. However, recent findings reveal a new culprit for T1D. Registries reveal that the incidence of T1D has increased 3.9% annually from 1989 to 2003.⁸ Additionally, 70% of T1D cases involve genetic predisposition, while only 3%-7% of children with those high-risk alleles develop diabetes. Both the rapid rate of increase and the discrepancy between the T1D cases and high-risk alleles suggest that non-genetic factors impact the occurrence of T1D.⁸ One Harvard longitudinal study points to the human microbiome as a mechanism for T1D development.

With medicine focusing on the eradication of pathogenic diseases, it is often easy to discount the role of symbiotic bacteria in human health. The microbiome is an ecosystem of Eukarya, Bacteria, Archaea, and viruses that inhabit the body, accounting for 9 out of every 10 cells. These microorganisms occupy every body structure in clusters called microbiota, each helping to regulate the host's immune system, keeping pathogen existence to a minimum and affecting immunologic expression. They also play an enormous role in the gut ecosystem, performing necessary actions for digestion and nutrient uptake.

As more cases of chronic disease are linked to microbiome interactions, scientists are beginning to realize the role of the metagenome, the entire genome in the human ecosystem including that of the host, in personal health. For example, there are 22,000 genes present in the human genome with 99% similarity among different individuals. On the other hand, there are 3.3 million non-redundant microbial genes in the human gut alone, along with 80-90% disparity in microbiome of the hand and gut between individuals.¹⁰ Taking this metagenome into account, several links have been made between chronic autoimmune diseases such as Type I Diabetes (T1D) and the microbiome. This physiologic and genomic interplay between host and microbes adds depth to the definition of personal health and opens a new avenue for personalized medicine.

**MICROBIOME DEFINITION**

Humans obtain their microbiomes through their surroundings, leading to unique microbial fingerprints. Because the initial microbiome is developed at birth, factors such vaginal or cesarean section delivery, hospitalized or home deliveries, and microbes of the mother and household have important long-lasting impacts on microbiome development. Children often develop their first microbiomes from delivery and go on to acquire a more diverse array of flora through their diet and the world around them. As a child grows different microorganisms compete for different locations, leading the most fit organisms to inhabit their respective niches. By age three, a child has acquired a stable biome, which goes on to steadily change throughout development with some key chronological checkpoints such as puberty and pregnancy.⁴

**IMPACT OF THE MICROBIOME**

With both microorganisms and human cells living in such tight conjunction, it is important to realize the symbiotic interaction between host and microbe. Oftentimes when this balance is thrown off, dysbiosis results in which there is a disruption in the natural homeostatic relationship between the microbes and the host. Taking this into account, researchers have speculated that changing exposures to microbes have an influence on other diseases. For instance, global hospital trends have led to hypotheses on association between increase in hospital sanitation and a rise in T1D incidences.³ Further support for this “hygiene hypothesis”, is the disproportionate prevalence of autoimmune diseases throughout developed countries, where exposure to microorganisms is limited during childhood, therefore negatively
host cells. There are two components to the human gene-pool. The increased fluidity, having the ability to evolve more quickly than microbiome enlarge the gene-pool of an individual, it also exhibits the body through personalized medicine. Not only does the microbiome provide an additional unique avenue to impact improve microbiome symbiosis and therefore body function? could we not apply patient-specific therapy to both alleviate and modification, leading to different microbiome compositions.3 Additional sequencing has shown other gene loci specific microbial species, containing genes that involve immune correlating with phenotypic variation, have shown linkage with system development. This study illustrates both the deleterious and beneficial functions of the microbiome. These microbiome regulatory pathways on the body are in the process of being better understood but can be generalized into two categories: epigenetic gene modification through either live microorganisms or secretion of metabolites.

Conversely, host genome and immune expression have a substantial impact on the assembly of bacterial communities. For instance, there is a genetic source for microbiome regulation. Eighteen quantitative trait loci (QTL), sections of DNA that correlate with phenotypic variation, have shown linkage with specific microbial species, containing genes that involve immune signaling.5 Additional sequencing has shown other gene loci to affect microbe variation through T-cell enhancement and modification, leading to different microbiome compositions.

POTENTIAL FOR PERSONALIZED MEDICINE

If this ecosystem of microbes so profoundly impacts our health, could we not apply patient-specific therapy to both alleviate and improve microbiome symbiosis and therefore body function? The microbiome provides an additional unique avenue to impact the body through personalized medicine. Not only does the microbiome enlarge the gene-pool of an individual, it also exhibits increased fluidity, having the ability to evolve more quickly than host cells. There are two components to the human gene-pool. The first is the stable, inherited gene-pool that generally remains the same throughout an individual’s lifetime. The second is a cloud of malleable microbiota that changes with time, health, space, and hormonal states.9,10 Already treatments are being developed to extract, preserve, and transplant microbial communities between individuals for the treatment of infections by Cloristridium Dificil. Additionally, there is a growing market of microbiome targeting drugs and probiotic supplements.

CONCLUSION

The unique microbiome of every exerts specific regulations on immune expression and nutrient uptake to shape health. This specific metagenome and microbiome of every individual provides an opening to apply personalized medicine. For instance, development in microbiome understanding and technology will open avenues for autoimmune prevention and treatment of T1D. Other diseases impacted by the microbiome that have high potential for microbiome therapy include Inflammatory Bowel Syndrome, which includes Crohn’s Disease (CD) and Ulcerative Colitis (UC). More research must be performed to reveal the precise mechanisms between microbes and the body. However, after this hurdle and the following hurdle of treatment regulation, it is clear to see that a world exists where auto-immune diseases of the microbiome can be prevented and treated.

References
Modern advances in medicine have improved the quality and length of most human lives tremendously, but, as of now, few technological improvements have been able to safely and effectively replicate the functions of human kidneys. Consequently, the only true substitute for a failing kidney is a healthier one. Because kidneys play such an essential role in our bodies, individuals with end-stage renal disease often receive replacement organs from registered donors who have passed away. While this process of recycling human tissues is a practical method, there are many factors that limit the success of such transplants, namely the reality that the demand for kidneys far exceeds the supply.

What if we could increase the supply to better fulfill these demands? Research from the University of Pennsylvania suggests that the supply of transplantable kidneys could possibly be increased by taking kidneys from deceased individuals who were previously disqualified from donating because they had infectious diseases. With the recent discovery of medications that can cure hepatitis C (hep C) in more than 95% of patients, individuals with such infectious diseases can now donate their organs to patients who will undergo treatment after transplantation. Research conducted by Dr. David Goldberg, MD, MSCE, a successful Penn hepatologist, and Dr. David Reese, MD, MSCE, an accomplished Penn nephrologist, has promising implications for transplants from hep C positive donors that inspire hope for the future of transplant medicine.

Statistics portraying the dismaying shortage of kidneys allow us to fully recognize the significance of Dr. Goldberg’s and Dr. Reese’s research. In January of 2016, approximately 100,000 people were in marked need of kidney transplants. Tragically, the kidney transplant waiting list grows by one person every 14 minutes and 13 people die each day simply waiting on the list. To make matters even worse, the average wait time for people on the list is 3.6 years and only 16,000 kidney transplants are performed each year. At this rate, the waiting list will grow dramatically, with more and more patients dying as they wait for transplants. How can we intervene to reduce this growing strain?

Dr. Goldberg, Dr. Reese, and their colleagues at Penn are working on testing the effectiveness of an innovative method to increase the number of transplanted kidneys. In their current study, 10 patients have been taken from the kidney transplant list and have received kidneys from donors who were infected with hepatitis C, an infectious liver disease caused by the hepatitis C virus that was diagnosed acutely in 30,500 patients in 2014. Additionally, there are over 3 million patients who are chronically afflicted with this disease at this time. Although hep C does not cause direct damage to kidneys, infected cells can be found in the kidneys that are transferred to organ recipients. This complication can potentially cause more harm than good in patients with compromised immune systems. However, the production of curative drugs like Sovaldi in 2014, Harvoni in 2015, and Zepatier in 2016 has enabled physicians to explore new methods of utilizing these infected organs for transplants. In fact, by inhibiting the action of two key hep C components, a protease enzyme called NS3/4A and a protein used in RNA replication called NS5A, Zepatier has been found to cure 94%-100% of hep C patients in clinical trials. When asked about the origin of this idea, Dr. Goldberg noted that his group was not the first to engender this solution. “It is something that many people have thought of, but we were the first to get the study off the ground,” stated Dr. Goldberg as he shared that a similar study is being conducted at Johns Hopkins. In his current research protocol, one cohort of patients received transplants from infected donors and have been treated with Merck’s hep C drug, Zepatier.
The decision to use Zepatier over drugs like Sovaldi and Harvoni was based on two primary reasons. First, since hep C treatments can be extraordinarily expensive, with the price of Harvoni reaching as high as $94,500, it was clear that grants from Penn alone would not be enough to support the study. Dr. Goldberg and Dr. Reese had consequently reached out to Merck to see if they would be interested in funding parts of the study. Merck’s cooperation with the researchers allowed the company to play a large role in the study and provide dosages of Zepatier at a more affordable level. Second, the fact that Zepatier, unlike other hep C drugs, can be used in patients whose kidneys fail was a huge plus.

After the patients are given some time to recover, they begin a 12-week regimen of treatment with Zepatier. Since the study is still being conducted, data and results cannot be disclosed, but Dr. Goldberg has suggested that no unexpected complications from the transplants or the infections have arisen.

Going forward, Dr. Goldberg has an optimistic view for the study and for the implications of transplanting diseased organs that can be subsequently cured by pharmaceuticals advances. The study is predicted to conclude in June of 2018, so the most accurate results of the treatments should be available within a few weeks of that point in time. As of now, it is unclear whether or not this style of transplantation and treatment can be applied to other organ transplants. Although hep C does not affect the lungs or heart, the infection is carried within those tissues, so transplants from infected individuals would still require treatment with drugs similar to Zepatier. One of the biggest limitations for these types of transplants, though, is that the patients who receive heart or lung transplants are typically not healthy enough to deal with another infection being added to their list of maladies. Furthermore, none of the hep C medications on the market can be administered with a feeding tube, so treatment would have to begin several weeks into recovery from the transplant. This could result in the infection causing significant harm in the recipient before the initiation of treatment, possibly leading to further complications in recovery.

The research being conducted by Dr. Goldberg, Dr. Reese, and their team at Penn, as well as similar studies that are ongoing at Johns Hopkins, is unequivocally promising for the lives of men, women, and children on the kidney transplant waiting list. It is crucial, however, that doctors and scientists alike be aware of the values that they must uphold when it comes to their research. “The right approach is that it has to be in an IRB approved research protocol to ensure that patients are safe and that things are done in a standardized fashion,” said Dr. Goldberg of the future pathways into this field. It is abundantly clear that even the most progressive procedures and methodologies must fall in line with guidelines to put the lives of patients first.

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References

ANTI-AGING ADVANCEMENTS: HITTING REWIND ON NATURAL DECLINE

It is a common stereotype that as individuals become older, they become more prone to illness. However, recent advancements in anti-aging research may cause this stereotype to not hold true. One of the telltale signs of aging is an accumulation of senescent cells, older cells that lose their ability to divide due to DNA telomere shortening or outside stress. Following the adage that Father Time can’t be defeated is the underlying scientific definition of aging as a progressive impairment of function that increases vulnerability towards disease and death. The age-associated accumulation of senescent cells has been linked to various diseases affecting every bodily system, ranging from cancers to fibrosis to atherosclerosis. As such, scientists have long been looking for discoveries in slowing or reversing the effects of aging to allow for prolonged and healthier life.

REPROGRAMMING CELLULAR PLURIPOTENCY

Although aging is generally considered to be an inevitable, irreversible process, studies have revealed it is actually more malleable than previously thought. By manipulating specific signaling pathways, Yamanaka, a Nobel-Prize winning stem cell researcher, demonstrated that terminally differentiated cells can be reprogrammed into a pluripotent-embryonic like state. He found that cellular reprogramming back to pluripotency, an earlier state when a stem cell is capable of giving rise to different cell types, can be accomplished by expressing certain transcription factors called Yamanaka factors (Oct4, Sox2, Klf4, and c-Myc) [OKSM]. Furthermore, the forced expression of the identified Yamanaka factors is accomplished through the remodeling of epigenetic markers, such as DNA methylation, chromatin remodeling and histone modification. Coincidentally, epigenetic deregulation, which can be reversed through cellular reprogramming, is a key hallmark of the aging process. For example, an emerging epigenetic trend detected in aging cells is the general loss of histones, basic proteins that package DNA into nucleosomes. Many groups have observed an amelioration of age-associated cellular phenotypes, like histone loss, during in vitro cellular reprogramming studies. More specifically, reprogramming cells from patients with Hutchinson-Gilford progeria syndrome, a disorder characterized by premature aging, resets telomere size, and gene expression profiles, resulting in a generation of rejuvenated cells. To move forward, however, in vivo studies are critical to better understand how cellular reprogramming may actually affect cellular and organism aging.

Implementation of in vivo studies has proven difficult because studies have shown how in vivo induction of OSKM can lead to a teratoma (a tumor with components from more than one cell layer) formation. Through standard in vivo pluripotent cell induction protocols, extended induction can lead to the development of cancer. In 2016, however, Ocampo et al. circumvented this issue by discovering that a cyclic OSKM induction protocol, a protocol in which OSKM is induced for two days followed by 5 days of treatment rest, safely induced OSKM in mice safely without leading to weight loss or higher mortality rates.

After administering this cyclic OSKM protocol in mice with progeria, Juan Carlos Izpisua Belmonte of Salk found that mice that have undergone cellular reprogramming lived 30% longer than the control untreated progeria mice. Furthermore, older mice that were treated with OSKM induction for three weeks had significantly faster muscle regeneration rates from muscle injury as opposed to the control wild-type mice. These results highlight the potential for cellular reprogramming in the amelioration of age-associated phenotypes.

ELIMINATING HARMFUL SENESCENT CELLS

Beyond cellular reprogramming, removing deleterious cells is also promising in anti-aging research. Cells senescence after suffering DNA damage or other types of stress, losing the ability to divide. These stagnant senescent cells release chemicals that help wounds heal but have been found to accumulate in mature tissue and secrete factors that are harmful to tissue function and neighboring cells. Studies suggest that chronic secretion of pro-inflam-
matory factors by these senescent cells keeps neighboring cells in a permanent stem-like state and thereby prevents proper tissue renewal. Furthermore, the chemicals released by senescent cells can damage surrounding tissues and even promote tumor growth. In trying to reduce the harms of senescent cells, Jan van Deursen, a cancer biologist from the Mayo Clinic College of Medicine, et al. genetically engineered a strain of fast-aging mice so their senescent cells committed suicide in response specific drugs. Through this strategy, removing the senescent cells slowed the mice’s physical breakdown as they got older but had no impact on lifespan. To test if the same strategy worked with normally aging mice, van Deursen and his team genetically modified two other mice strains to kill their own senescent cells after receiving the same drug. When the rodents reached middle age, the researchers began injecting them with the compound twice a week. Although the procedure couldn’t eliminate all the senescent cells from the animals, it could kill 50% to 70% of senescent cells in the mice’s tissues. By killing a majority of senescent cells, researchers discovered that naturally aging mice lived 25% longer. Furthermore, removing senescent cells also proved helpful in improving general resistance against disease. For example, removing senescent cells from the immune system that amass in artery clogging plaques, reduced the amount of fatty acid buildup in arteries by 60%. Not all age-related problems in the mice improved, however. Their memory, muscle strength, coordination, and balance—all of which decline as we grow older—were no better than those of control rodents. Deleting senescent cells doesn’t spare the animals from aging entirely, van Deursen cautions. “It has an attenuating effect. You still get age-dependent [changes], and the mice still die.”

Geneticist Ned Sharpless of the University of North Carolina School of Medicine notes that there are many other approaches in slowing aging such as deleting certain genes or cutting calories. For the first time however, these advancements represent some of the most feasible breakthroughs to actually get implemented in human trials. Researchers have a clear goal in mind now. They can say, “if I can figure out a way to kill senescent cells with a small molecule or an antibody, I could do a clinical trial” or “if I can develop new easier to implement of achieve cellular rejuvenating, I could do a clinical trial.”

“I do foresee the use of chemicals that induce cellular reprogramming and rejuvenation of tissues and organs in humans,” Salk said. “These chemicals could be administered in creams or injections to rejuvenate skin, muscle or bones. We think these chemical approaches might be in human clinical trials in the next 10 years.”

References

AN EMERGING EPIGENETIC TREND DETECTED IN AGING CELLS IS THE GENERAL LOSS OF HISTONES, BASIC PROTEINS THAT PACKAGE DNA INTO NUCLEOSOMES.

GENETICIST NED SHARPLESS OF THE UNIVERSITY OF NORTH CAROLINA SCHOOL OF MEDICINE NOTES THAT THERE ARE MANY OTHER APPROACHES IN SLOWING AGING SUCH AS DELETING CERTAIN GENES OR CUTTING CALORIES.
Biomedical researchers aspire to draw a clean, straight line between understanding the mechanism of genetic diseases to discovering their remedial drugs. The complex nature of biology often distorts this dream; however, this has not been the case with the recent breakthrough in the treatment for Spinal Muscular Atrophy (SMA), a disease that robs its victims of the ability to walk, eat, and breathe. The treatment, known as nusinersen, has recently gained FDA approval, making it the first and only therapy for SMA.1

WHAT IS SPINAL MUSCULAR ATROPHY?

SMA is a disease that results in the loss of motor neurons in the spinal cord and brainstem.2 The destruction of these nerve cells can be fatal, as they are responsible for such critical processes as swallowing and breathing. In fact, toddlers severely affected by the disease eventually suffocate due to a lack of functional respiratory muscles.3

Fortunately, there is another gene called Survival Motor Neuron gene 2 that produces a modest amount of the survival motor neuron protein. SMA patients who have several copies of this SMN2 gene have a higher chance of surviving into adulthood, but they must deal with progressive and often paralyzing weakness.7

HOW COMMON IS SPINAL MUSCULAR ATROPHY?

As of now, SMA is the most common genetic cause of death in childhood. It is estimated that one in 50 adults are asymptomatic carriers of a flaw in the SMN1 gene. Children who inherit two copies of the flawed gene – about one in 8000 to 12,000 infants – almost entirely lack the SMN protein.8 In these severe cases, it is highly unlikely that the child will survive to adolescence. Fortunately, the survival rate of SMA is expected to increase substantially due to the invention of a new therapy called nusinersen.

HOW DOES NUSINERSEN WORK?

The nucleus of the nerve cells contains the SMN1 and SMN2 genes. As previously explained, the SMN1 gene of SMA patients does not produce sufficient quantities of the SMN protein, thereby leaving patients with a dependence on the SMN2 gene. The SMN2 gene passes “blueprints” for creating the SMN protein to a messenger RNA (mRNA) molecule. The mRNA then carries these blueprints outside the nucleus of the cell and into the cytoplasm where the SMN protein is made. However, a problem arises as a portion of the instructions for creating the SMN protein is lost as the mRNA molecule passes through the nuclear membrane. Specifically, a key portion of the protein-coding genetic sequence called exon 7 is spliced out, which ultimately results in the production of a rapidly degrading, truncated version of the SMN protein. Nusinersen is a snippet of modified nucleic acid, known as an antisense oligonucleotide (ASO), that complements part of the mRNA mol-
ecule made by SMN2 and ensures that exon 7 is included as the mRNA passes through the nuclear membrane. Nusinersen acts as a molecular patch by binding to the single-stranded mRNA molecule and coaxing the spliceosome to incorporate exon 7. This ultimately allows for the production of full-length, functional SMN proteins to be made from SMN2.

**NUSINERSEN ACTS AS A MOLECULAR PATCH BY BINDING TO THE SINGLE-STRANDED mRNA MOLECULE AND COAXING THE SPLICEOSOME TO INCORPORATE EXON 7. THIS ULTIMATELY ALLOWS FOR THE PRODUCTION OF FULL-LENGTH, FUNCTIONAL SMN PROTEINS TO BE MADE FROM SMN2.**

**HOW EFFECTIVE IS NUSINERSEN?**

The efficacy of nusinersen is made clear through two late-stage clinical trials. The first used a sample of 84 wheelchair-bound children. Half of these children were given the nusinersen therapy, while the other half of the group was given a placebo. The experimental group receiving treatment showed exponential improvement in movements such as sitting, standing, and taking steps. In fact, researchers reported a highly statistically significant improvement in 33 tests movement. Thus, the study was stopped on the grounds that it was unethical to refuse the treatment for the control group, as the benefits of the drug were clear. Similarly, a clinical trial with 121 infants who had a severe, fatal form of the disease was stopped so the 41 infants in the control group could receive the lifesaving treatment. In light of these promising clinical trials, the FDA approved the use of nusinersen for all infants suffering from SMA in December of 2016.

**CONCLUSION**

The long road to FDA approval of nusinersen required a team effort from researchers, nonprofits, companies, families, and physicians. Through nonprofit and family donations to companies funding the work of researchers and physicians, the path of nusinersen acts as a template for future drug development processes and therapies. Jill Jarecki, who leads the Cure SMA foundation that invested over $59 million to research, rejoices, “Cure SMA and our entire community have worked tirelessly for more than thirty years to make this happen. It is important for all of us to stop and celebrate the shared accomplishment that will change and improve the lives of SMA patients.”

References

Hospitals are where people go to get better, not to get infected. At hospitals, doctors and nurses perform hand hygiene before they interact with their patients. They wear masks, goggles, and gloves. Operating rooms are sterilized. However, despite hospitals’ best efforts, Hospital Acquired Infections (HAIs) continue to occur at an alarming rate.

**WHAT IS AN HAI, AND WHO IS AT RISK?**

An HAI, also known as a Nosocomial infection, is an infection that a patient contracts while receiving treatment at any healthcare facility. HAIs occur in acute care hospitals, ambulatory surgical centers, dialysis facilities, outpatient facilities, and long-term facilities. It is estimated that 1 in 25 hospital patients (4%) will acquire an HAI during their stay.

Although anyone can get an HAI, some patients are at increased risk. There are several factors that contribute to a patient’s risk of contracting an HAI. The more invasive the procedure, the higher the patient is at risk for an HAI. The longer the length of stay, the greater the chance a patient has of contracting an HAI. Similar to many other diseases and infections, the very young, very old, and immunocompromised are more susceptible to HAIs. Smokers are also generally more likely to get an HAI.

**SITES OF INFECTION**

The most common types of HAIs include central line associated bloodstream infections (CLABSI), catheter associated urinary tract infections (CAUTI), surgical site infections (SSI), and ventilator-associated pneumonia (VAP).

CLABSIs, the most common type of HAI, occur if bacteria or viruses enter a patient’s bloodstream through a central line. These infections result in a mortality rate of 12% to 25%. Thousands of patients get CLABSIs every year. However, in recent years, the number of patients contracting CLABSIs has decreased. It was estimated that 43,000 patients contracted a CLABSI in 2001; the number had decreased to 18,000 in 2009. This may be due to an increased prevalence of CLABSI prevention policies such as chlorhexidine for skin antisepsis, using the subclavian vein as the insertion point of choice, and maximal sterile barrier precautions.

Microorganisms that often contribute to a CAUTI include *Escherichia coli*, *Staphylococcus*, and *Pseudomonas aeruginosa*. CAUTIs are common, accounting for 30% of HAIs in acute care facilities and over 50% of HAIs in long-term care facilities. CAUTIs are associated with longer lengths of stay and increased mortality. Women and older adults (age 60 and older) are more likely to get a CAUTI, though not all cases are symptomatic. There has not been significant progress in decreasing CAUTI rates in ICUs.

SSIs can occur during or after a patient’s surgery. Less serious SSIs only infect the skin, while more serious SSIs penetrate into deeper tissue or an implanted device. Patients with SSIs have their hospital stay increased by 7-11 postoperative days, on average. It is estimated that up to 60% of SSIs may be preventable. From 2009 to 2014, SSI rates decreased 17%, but there is still significant risk with hip or knee arthroplasties, coronary artery bypass grafts, peripheral vascular bypass surgeries, aortic aneurysm repairs, and hysterectomies.

VAP is pneumonia that occurs “more than 48 hours after patients have been intubated and received mechanical ventilation.” It is the second most common HAI in critically ill patients. Patients who contract ventilator-associated pneumonia have a hospital stay that is on average 4-13 days longer than those without the infection.

**COMMON PATHOGENS**

Many pathogens infect patients in hospitals. These pathogens include *Acinetobacter*, *Burkholderia cepacia*, *Clostridium difficile* (C. diff), *Clostridium sordellii*, Hepatitis, HIV, Influenza, Methicillin-resistant *Staphylococcus aureus* (MRSA), Norovirus, Tuberculosis and more.

C. diff is a bacterium that may normally live in the gut. About 3 out of 100 healthy people have C. diff, but the C. diff are kept at a small population by other microbiota that live in the gut. C. diff HAIs usually occur after a patient has gone through a course of antibiotics. C. diff is spread when an individual touches a surface contaminated with C. diff spores and then touches their mouth.
diff spores are more effectively killed by washing hands with soap and water than by using hand sanitizer.15

Patients who are on antibiotics or have just taken an antibiotic are 7–10 times more likely to get infected. Symptoms of the infection usually start to occur 5–10 days after starting a course of antibiotics but may present later.16 Broad spectrum antibiotics such as cephalosporins, fluoroquinolones, extended-coverge penicillins, and clindamycin are more likely to contribute to a C. diff infection than are narrow spectrum antibiotics.17 People taking stomach ulcer drugs also have a higher chance of contracting C. diff. They are more at risk for infection because when antibiotics kill the beneficial gut bacteria, C. diff can flourish. This can cause mild diarrhea that will resolve on its own or be life threatening. It can be treated with a new course of antibiotics or with a fecal transplant. C. diff is extremely problematic, in part due to its high recurrence rate.1 1 out of every 5 people who get infected will be re-infected. 1 in 11 patients age 65 and older who infected will die within a month.16

Similar to C. diff colonization in the human body, S. aureus colonizes in 33% of people’s noses but does not cause any illness. Methicillin-resistant Staphylococcus aureus bacteria, MRSA, are resistant to beta-lactam antibiotics. 2 in every 100 people’s noses are colonized by MRSA with no adverse effect.18 MRSA is spread by direct contact. Risk factors for contracting MRSA include being hospitalized, having an invasive medical device, and being in a long-term care facility. People who carry MRSA but are not infected can also spread MRSA in healthcare settings. When MRSA gets into a patient’s deeper tissues or organs, it can cause septic shock, endocarditis, or pneumonia. Fortunately, in recent years, MRSA HAIs have been declining in number, in part due to prevention programs.19 From October 2007 to September 2015, there were significant decreases in HAIs in VA hospitals, especially regarding MRSA cases. In long term care settings, MRSA rates went down 49.4%. MRSA prevention programs were put into place. These programs include a dedicated MRSA prevention coordinator at each facility and bundled interventions which include universal active surveillance on admission and contact precautions for those not only infected with MRSA but also those colonized by it.20

Patients who acquire an infection in the hospital spend more time in the hospital. On average, an infected patient will stay 6.5 extra days in the hospital. These patients also have higher re-admittance rates.4 HAIs also create huge monetary expenses of about $9.8 billion per year as of 2013. Medicare has a nonpayment policy for treating CLASBs, CAUTIs, and SSIs, leaving the bill on the hospital. This may incentivize hospitals to take more preventative measures.21

**PATIENT PREVENTION**

Patients can play a big role in preventing HAIs by speaking up and voicing their concerns to their doctors and nurses. However, this happens less than it should. One reason patients don’t speak up is that they often assume they don’t have to. Elderly patients are less likely to speak up because they may fear insulting the staff and tend to be more respectful of rules and authority.22 Suggestions for patients include having someone else there with them that will make them feel confident about talking to their doctor, knowing what to say in advance, and prioritizing concerns.23

Patients should not be afraid to ask their providers to wash their hands if they did not see that happen.24 They should also keep their own hands clean. Patients should also be aware that not all prescribed antibiotics are necessary and that being on a long-term antibiotic increases risk of C. diff. Patients should look for signs and symptoms of infections so that they can be taken care of sooner. Staying up to date on vaccinations, such as an annual flu shot, can also prove to be beneficial should a patient unexpectedly be hospitalized.24 To reduce the chance of getting an SSI, there are more specific measures a patient can take. If directed by their doctor to use a certain kind of soap before the surgery, the patient should do so. The patient should also avoid shaving near the surgical site. To reduce the risk of acquiring MRSA, patients should also avoid sharing personal items.25

**Hospital Acquired Infections are not a new issue, but they are a huge cause for concern because they kill thousands of patients every year. It is important to realize that many HAIs are preventable and that both healthcare workers and patients can reduce risk by being informed and careful.**

**References**


**Preventing HAIS**

1. Providers and patients should always wash hands.
2. Be smart about antibiotic use.
3. Protect self by getting vaccinated.

**GRAPHIC/ALICIA GO**
GENOMIC MEDICINE
An Inevitable Frontier
BY LIAM BARTIE

Now more than ever should healthcare focus its efforts on comprehending and manipulating the genome for beneficial purposes. Further understanding of genetics on a molecular level is perhaps the most valuable intellectual asset of the present day—that is, in terms of the extent to which it can increase medical productivity. In much the same way that someone's genome can reveal aspects of their physiology or even personality, it can conceal immunological secrets that may be the key to conquering disease on a more comprehensive level. Contemporary research has been adhering to this path more closely since the first studies in which researchers investigated a single gene in a cohort of patients searching disease-related mutations, today almost all complex diseases have been investigated through genome wide association studies (GWAS). The principal goal of these studies is to identify certain genes or loci that qualify as disease-related variants. Sequencing these variants and integrating clinical observations over a wide range of patients enables healthcare professionals to understand each malady on a more precise level mechanistically; naturally, this can inform cure efforts in unanticipated ways.

PHARMACOGENOMICS

Drug development that focuses on mapping the genetic code is known as pharmacogenomics. Through this approach, researchers have had success in many areas that have characteristically eluded traditional research techniques. For example, Dr. J.J. Trinks and a team working at the Hospital Italiano de Buenos Aires experienced breakthroughs in antiviral treatment for Hepatitis C. Identifying a particular polymorphism at a location known as the interleukin 28B gene enabled the doctors to design a therapeutic technique for the disease that successfully resulted in favorable new genotypes. Essentially, restructuring the molecular genetic architecture could make the deadly virus phenotypically inept. Creating this dysfunctional phenotype results in a pathogen that cannot carry out its virulent activities because some observable characteristic has been altered to make the virus benign. In this particular instance, the variants were observed to have inactive protein expression. Without protein expression, the organism could not carry out its life-sustaining activities, and thus ceased to cause bodily harm.

Pharmacogenomics also has vast implications in treating cancer. Although cancer treatments continue to improve for various permutations of malignant bodily tumors, halting the disease at a molecular level still stumps most expert oncologists.

The implications of pharmacogenomics in treating cancer are vast. Although cancer treatments continue to improve for various permutations of malignant bodily tumors, halting the disease at a molecular level still stumps most expert oncologists. However, it is likely that the key to cancer therapy lies at a particular locus or loci yet to be determined.

Beyond identifying and pinpointing cancerous tissue at early stages, genomic techniques can optimize treatment based on the personal data and diagnosis of patients. Correlation exists between certain genetic profiles and positive response to a chemotherapy drugs or other therapeutic techniques. The case of the HER2 gene in breast cancer exemplifies the utility of this treatment paradigm. Overexpression and amplification of HER2 in breast cancer is a strong predictor of benefit from the antibody trastuzumab. Being able to swiftly identify genetic red flags and suggest a precise therapy option presents a
huge advantage in the quality of care a patient will receive. Especially for many strains of cancer, reducing the time before a successful treatment is found is a key factor in increasing the survival rate of that group.

**POLICY INTEGRATION**

The medical utility of personalized treatment will sooner or later redefine the market for healthcare. Given the fact that treatment will become inherently different for each individual, demand and costs will have to undergo a massive reassessment as genomics are integrated more heavily in the clinical setting. A similar concept applies to drug design, as pharmacological targets will become significantly more specific, meriting the production of many chemically-distinct compounds for just one ailment. Think about the effect this could have on the many monopolies currently held by the pharmaceutical industry: a larger new generation of unique drug patents are likely to emerge. As IBM managing consultant Aditya Pai says, “The likely scenario within a decade is the common availability of whole-genome sequencing with a pharmacogenomic profile that provides a comprehensive risk assessment for various genetic and multifactorial conditions and a list of personalized drugs with personalized dosages based on an individual’s genotype.”4 This risk-assessment will in turn become one of the major contributors to a new healthcare policy design.

Even non-financial aspects of healthcare will undergo a modernizing transformation due to the availability of genomic information. Ethically, there are concerns about making sure the genotype information generated for medical purposes does not leave the property of the patient and his or her healthcare professional. Technology, especially software with knowledge to genetics targets, may redefine the job of a physician in certain circumstances.6

Integrating genomic information into every medical decision is a future that healthcare has yet to realize. The personalization of both drugs and clinical treatment is the next paradigm shift that medicine may not be ready for. For one, the economic restructuring of the healthcare industry is a massive policy realignment that will require government to catch up with science before it can intend to implement coherent sanctions. Government industries such as the FDA will undergo top-to-bottom reorganization, forming new committees to determine how to ensure a safe transition. Regulations will be inherently more difficult to impose due to the highly-personalized diagnoses and recommended therapy. Additionally, breakthroughs in molecular technique are not finite for many of the instances that seem promising at present. Further research is necessary to solidify the ability of pharmacogenomics to remedy more serious ailments, namely the various instances of cancer that have seen early progress. While society is admittedly ill-prepared to begin the metamorphosis that a genomic approach to healthcare will induce, it will have to endure any consequences that the inevitable future holds.

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Faith and Medicine:

BY GABRIELLE RAMIREZ

Religious. To some, it means living a life of morals and loyalty to fundamentals. To others, it is synonymous to dogmatic. According to Merriam-Webster, religious is defined as "of, relating to, or devoted to religious beliefs or observances." Thus, a religious physician is simply a physician devoted to religious beliefs. For centuries, the issue of religion was hardly a point of contention between religious and non-religious physicians. Recently, however, stigmas have been brought to light that come from non-religious to religious physicians.

Currently, much literature exists on the effect of patients’ religious beliefs on their treatment and physicians’ medical decisions. However, little is known about how physicians’ religious commitments shape their medical practices. This leads many to speculate whether faith and medicine can truly exist and, if so, the influence of faith on medicine. A better understanding of the physician’s religious beliefs could help prevent conflict and strengthen the patient-physician relationship.

THE FACTS

America is becoming less religious. A 2014 survey conducted by Pew Research Center indicates a decline, approximately 92% to 89%, in adults who believe in a God. More surprisingly, only about half of Millennials say they believe in God, and only about 40% of Millennials say religion is very important.¹

Despite this trend, physicians continue to be open to religion, even if they don’t identify as “religious physicians.” According to a survey conducted by the University of Chicago, 76% of doctors believe in God, and 59% believe in some sort of afterlife.² 55% of physicians say their religious beliefs influence their medical practice. In a survey of family physicians, 77% would pray with a patient if a patient requested it.³

THE RELIGIOUS PHYSICIAN’S PERSPECTIVE

Religious doctors are realistically not very different from secular physicians. They have passed the MCATs, attended medical school, and followed the Hippocratic Oath. The main distinction between these groups is the different views they have of their work. Religious physicians perceive themselves as a shining light in a field full of pain, suffering, anxiety, anger, and tears. Secular physicians predominantly believe they are trained healers with altruistic spirits. Despite the “distinction” between them, both types of physicians have the same end goal: to heal the sick. Just because a physician is religious doesn’t mean that religion dominates the entirety of his or her practice; even if it does, the patient’s health is always prioritized.

MEET DR. S: A BAPTIST AND OTOLARYNGOLOGIST

Dr. S, an otolaryngologist, is a religious physician. Dr. S believes God called him to serve others. While attending a Methodist-affiliated university, he became an ordained minister. When faced with applying to a selective residency at the New York Eye and Ear Infirmary, Dr. S prayed. He was one of four to be admitted.

Dr. S incorporates religious faith into his practice. Like many religious physicians, he practices medicine within his moral boundaries. According to him, incorporating religious beliefs makes medicine more humane, something most patients certainly appreciate. Sometimes, Dr. S even prays with his patients (as long as the patient indicates religiosity). Even if they themselves aren’t religious, Dr. S believes praying comforts them.

In addition, Dr. S has found a balance between religion and professionalism. For example, he does not believe in condemning people for their wrongdoings. One time, Dr. S had a patient who came in with an irritated nose. The patient admitted to smoking marijuana. Rather than lecture about the patients’ irresponsibility, Dr. S chose to inform the patient on the medical reasons why smoking
Dr. B is one of many physicians who believes in incorporating the values she learned from her religious background into her professional life. As a physician, she recognizes that she has protocols to follow. Dr. B understands that patients go to her seeking her medical expertise, not religious counseling, on their time and money. One time, Dr. B had a male patient request permission to return as a female. Though her religious beliefs may tell her that transitioning is wrong, Dr. B explains that it is her responsibility as a physician to serve her patient's needs. At the next appointment, the patient came dressed in her temple clothes. After her shift, she went to service. Ultimately, Dr. B found her own way of balancing religion and professionalism.

TO PROSPECTIVE RELIGIOUS PHYSICIANS

"At the end of the day, our care of our patients should be influenced ultimately by these words from Hippocrates himself, that we should “take care that they suffer no hurt or damage” from our decisions. Thankfully, this is in line with a particular teaching from…faith, that I should love my neighbor (meaning everyone else) as myself.”

It is difficult to be a religious physician today. However, this does not mean that achieving a balance between religion and professionalism is impossible. To those who are considering a career in medicine and have strong religious beliefs, do not give up. There are many resources available to those seeking guidance, such as faith leaders and current religious physicians among other professional circles. Undeniably, most religious physicians would advise that religion should be just one of many contributing factors in guiding medical practice. So, can faith and medicine coexist? They most definitely can.
"Burnout", generally defined as the exhaustion of physical or emotional motivation as a result of prolonged stress, has affected everyone from jaded college students to mothers working two or more jobs. In medicine, a field known to have long hours, high stakes, and heavy intellectual demands, this condition is far more prevalent than it is in other professions. Psychologist Christina Maslach defines physician burnout to be "an erosion of the soul caused by deterioration of one's values, dignities, spirit, and will."¹ Studies funded by the American Medical Association, the Mayo Clinic, and other organizations found that 54.4% of all participants self-reported seeing at least one sign of burnout in their personal lives² and that one out of every two American physicians were recorded experiencing at least one symptom of burnout.³ This startling statistic further proves the idea that physician burnout is a pervasive issue that affects everyone from the physician to the patient and demands more immediate action.

There are various stressors present in the medical field that contribute to the high rate of physician burnout. On their website, the American Medical Association recognizes seven such causes. Of these seven, perhaps the most common source of burnout is the presence of high amounts of stress.⁴ A survey in the UK found that on a scale from 0 (no stress) to 4 (extremely stressful), when asked to describe the stress they feel related to their occupation, 41% of physicians self-reported a 3 or higher.¹¹ Additionally, in a study conducted by Dr. Mark Linzer from Hennepin County Medical Center in Minneapolis, it was found that physicians operating under extreme forms of stress were 15 times more likely to suffer from burnout.⁴

Another common risk factor for physician burnout is, ironically, a general lack of self-care.⁴ Physicians are unable to prioritize their own mental and physical well-being due to the demands placed on them by their daily jobs. This is evident from stories like that of Dr. Eilis Clark, in which she recounts continuing her last year of residency regardless of the fact that she had cerclage for preterm, a procedure where a weakened cervix is sewed closed and requires that the mother remain on bedrest. This led to her water breaking while she was still working and her 21 week infant dying two hours after his birth.¹⁴ Unfortunately, Dr. Clark is not alone in her story and many physicians suffer from the impossible choice of choosing...
between their own self-care and fulfilling the demands of the medical profession.

Furthermore, physicians are trained to not project any stress or hesitation onto their patients, forcing them to maintain a friendly and calm demeanor. The fact that many physicians are often forced to act as “emotional” buffers for their patients further increases the likelihood that they will feel burnt out. One emergency physician, who was revived after an attempt to end his life claimed that his decision to commit suicide was “100% work-related.” He goes on to elaborate that his decision was spurred by losing a young girl to influenza. He carried out the appropriate protocols and eventually discharged the girl only to have her return less than two days later in respiratory arrest. While the parents blamed the death of their daughter on him and he was terminated from his job, he claims the worst part of situation was having to come to terms with another death without any counseling. He goes on to claim that while this one case may have immediately led him to end his life, the many cases of trauma and death he had to endure over his career as an emergency physician contributed greatly. This case exemplifies how physicians are often expected to simply put aside their personal emotions in order to keep serving patients.

One particularly detrimental consequence of burnout is an increase in physician drug abuse. According to Dr. Susan V. McCall, the medical director of the Oregon Health Professional Program, increasingly high levels of stress, continuous fatigue, and access to pharmaceuticals are some of the primary risk factors for addiction among health professionals. A recent survey shows that at least 17% of physicians claimed to personally know a fellow physician who engaged in substance abuse. According to another study conducted in 2013, about 10-12% of physicians develop a substance abuse problem while practicing, surpassing the rate of 9.4% in the general population for individuals that use illicit drugs.

Perhaps the most appalling aspect of physician burnout is the lack of diagnosis and treatment options for those facing the disease. The current method of treatment for physician burnout revolves mostly around individual care. Most physicians experiencing symptoms of burnout are recommended to take up hobbies and prioritize their physical well-being. The AMA created a program known as Step Forward that discusses methods to help eliminate burnout, including distributing wellness surveys and initiating selected interventions. In many cases, physicians go into counseling and occasionally antidepressants are prescribed to help them combat burnout. However, even this practice is controversial since researchers do not consider burnout to be a depressive or anxiety disorder but rather another disease altogether. Therefore, antidepressants only target some aspects of burnout and are not an effective form of treatment.

To truly combat the effects of burnout, it is important to begin implementation of changes on an institutional level. If we continue to put out the small fires by looking at each individual case, we will not be able to combat the larger firestorm that is physician burnout. Some possible changes used to battle large productivity pressures and long hours that contribute greatly to physician burnout include increasing medical school and residency acceptance rates and giving physicians more control over their own schedule. All in all, physician burnout is a genuine phenomenon that has severely damaging effects on our health care providers. It is necessary that we increase our awareness and do more to combat and put an end to this widespread disease.

References
Awake, alert, and fearless—desirable characteristics for partygoers and militants alike. Enter Captagon, otherwise known as Fenethylline—the wonder drug that swept the Middle East by storm in the early 21st century. Various societal factors that have allowed the rapid rise in popularity of Captagon among both Saudi Arabian youth and militants in the Islamic State of Iraq and Syria (ISIS). Evidence suggests that demographics, not chance, explain the drug’s prominence today.

**CAPTAGON: WHAT IS IT ANYWAY?**

Captagon is an amphetamine, similar to Adderall and Vyvanse. Amphetamines stimulate the central nervous system, fighting fatigue, increasing focus, and in some cases, lowering inhibitions. It was developed by a German pharmaceutical company in the 1960’s, and was used in subsequent years to treat ADHD (Attention Deficit Hyperactive Disorder), narcolepsy, and depression. The drug is typically taken orally, but in recent years there have been people who melt it down and inject it. Captagon was outlawed in most countries in the late 1980’s because of its highly addictive properties, as well as its side effects such as hallucinations, psychosis, heart failure, heart attacks, and seizures. Withdrawal symptoms include everything from headaches to depression.

After it was no longer approved for medical use, it found some footing in the illicit drug market, where its properties as a strong central nervous stimulant are desirable. The drug name Captagon was trademarked back when it was produced, but since legal production ceased, it is simply a name; many people producing it illicitly lace it with other substances including caffeine, Viagra, and in some cases, heroin. This leads to variance in market price, with pills ranging in price from around 10 USD to 25 USD, depending on what the drug is composed of. As mentioned before, the drug lowers inhibitions, lowers fatigue, increases focus, and, in sufficient amounts, can lead to feelings of euphoria or even hallucinations. Users have reported fearlessness, pleasure, increased energy, and reductions in their need for food and rest. Captagon’s relatively cheap, powerful high, is the main reason for its popularity in the Middle East.

**SAUDI ARABIA: IS INACTION A FORM OF ACTION?**

The Saudi Arabian government is notorious for shaping its policies with one goal in mind: to do whatever is necessary to protect its power. The country follows Shara law, under which alcohol and drug use are outlawed. Regardless, United Nations World Drug Reports have reported that Saudi Arabia has been a leading country in police amphetamine seizures, and that 64 percent of the world’s total amphetamine operation busts occurred in the Middle East in 2013. Shipments of Captagon aren’t just smuggled in shoeboxes, small batches in pockets or, pouches— in 2014, authorities intercepted a shipment of 17.7 million pills, worth well over 177 million USD.

In a society where alcohol and drugs are supposedly outlawed, 40 percent of the drug-using population uses Captagon. The drug is more popular than Hashish (a drug high in THC, the main active substance in Marijuana), cocaine, heroin, and Ecstasy, which are all present in the Middle East. This surprising percentage of users is further highlighted by the fact that more Saudis search for Captagon on the internet than in any other country around the world.²

Saudi authorities have outwardly expressed their desire to eradicate the drug problem, and have even accepted foreign aid from western countries. However, the Saudi Government also hides the full extent of the problem to avoid embarrassment over their failure to enforce Islamic ideals within their population.³ Experts theorize that Saudis consume so much of the drug because the ban on alcohol and recreational drugs under Sharia law doesn’t provide a legal outlet for the desire to party and have a good time.⁴ Further, as shown in a study conducted by Yahya Al-Nakeeb et al, Saudi Arabian kids and teenagers, on average, are

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² United Nations World Drug Reports
³ United Nations World Drug Reports
⁴ United Nations World Drug Reports
⁵ United Nations World Drug Reports
less physically active than their counterparts in the UK, another developed area. This is because in Saudi Arabian society, more emphasis is placed on academic pursuits and educational success than on sports and physical activity, which is why it makes sense that at least a small portion of the population takes Captagon for “academic” purposes—this cheap drug allows users to focus better on the task at hand and be more efficient when it comes to completing assignments. This also conforms with yet another common theory; some think that the drug is popular because the harmless pill can be associated with medicine, so it seems “less forbidden” in terms of Islamic Law. With no foreseeable changes in the socioeconomic and governmental systems in Saudi Arabia, it will be very difficult for any significant changes to occur that would inhibit the further spread of the drug.

**MONEY PILL: ISIS AND CAPTAGON**

Sustained terrorist operations, such as that of ISIS, tend to be expensive—occupying territory, paying member salaries, and purchasing weapons and supplies all add up. Because of the sheer size of operational costs, terror organizations often turn to illicit trade, such as weapon, human, and drug trafficking. This is certainly the case with ISIS, whose fighters both consume and produce Captagon pills for distribution across other areas in the Middle East.

Captagon is consumed in great quantities throughout the Islamic State due to the effects mentioned earlier. People who take it in small amounts experience heightened senses and lowered inhibitions. For fighters, the drug plays a similar role— they take it to avoid distractions such as hunger, fatigue, and fear. In one documentary, a Syrian fighter sums up his feelings while on Captagon, saying “If the commander told me to attack a military barracks, I will do it with a brave heart and without any fear.”

As long as supplies are available to produce the drug, roads and borders exist for the drug to be trafficked over, and a consumer base for the drug still has money to spend on the relatively cheap pills, there is no foreseeable circumstance under which Captagon will be completely eradicated. This pill has truly found a combination of circumstances that allow its popularity to unfold in unprecedented levels geopolitical, social, practical, and economic factors have aligned to yield, what is in fact, a perfect storm.

**SO, WHAT NEXT?**

Captagon— a simple, tiny, white pill— has taken the Middle East by storm. In Saudi Arabia, where the government downplays drug problems in its population to maintain a facade of absolute control, this drug finds popularity amongst young men who enjoy the cheap high that renders them awake, alert, and heightens sensory experiences. In the Islamic State, fighters not only gain economic profits from selling this drug, but also gain superhuman characteristics that they desperately need to be able to carry out many of the acts they commit.

**A SYRIAN FIGHTER SUMS UP HIS FEELINGS WHILE ON CAPTAGON, SAYING “IF THE COMMANDER TOLD ME TO ATTACK A MILITARY BARRACKS, I WILL DO IT WITH A BRAVE HEART AND WITHOUT ANY FEAR.”**

References

One Wednesday afternoon, Albert walks into his asthma specialist’s office for his regular checkup. Dr. A says, “How has your health been, Albert? Have you been taking the asthma medications I prescribed for you?” “I haven’t had the chance to lately, but it’s not that bad if I only missed three weeks of medication right?” said Albert, exhausted from working overtime.

The tale of Dr. A and Albert is unfortunately common. Three out of four Americans, like Albert, do not take their medications as prescribed. For example, one study showed that less than half of Schizophrenic patients adhere to antipsychotic drugs. The World Health Organization (WHO) defines non-adherence as the extent to which patients are not able to follow recommendations for prescribed treatment. In general, non-adherence does not depend on specific time constraints as it is a behavioral deficit that varies in degree with different patients. However, it can generally be understood to be the phenomenon where patients adhere irregularly (i.e. non-frequent usage to non-usage) to their prescribed medication regimen. Whether it’s a case of aversion to taking medications, or another motivator, there are many reasons why patients don’t take their medications as prescribed. Albert’s decision to miss his medication was influenced by a combination of his busy schedule and his belief that forgoing medication does not have significant consequences. Non-adherence is an issue doctors do not have much control over, as adherence to medications happens in the hours that the patient is outside the doctor’s office. Albert will unfortunately continue to suffer from severe asthma symptoms if he does not take his medications as prescribed. Additionally, non-adherence is costly to the healthcare system, with estimates showing the costs at $290 billion, or 13% of total healthcare expenditures. These costs derive from health expenditures for health complications resulting from non-adherent patients who continually seek medical care due to prolonged conditions. The healthcare system cannot afford such unnecessary spending. According to The National Health Expenditure Accounts (NHEA), national healthcare spending grew by 5.8% in 2015, reaching $3.2 trillion, or 17.8% of US GDP. With healthcare costs rising, it will be important for the medical community to tackle the issue of non-adherence, as it plays a big role in both unsustainable healthcare expenditures and poor health outcomes.

Medication non-adherence (or non-compliance) has far-reaching impacts on the United States economy. Within the elderly, even the lowest estimates of non-adherence are a staggering 40%, with the upper bound pushing 75%. For example, 30% to 70% of asthmatic patients are non-adherent. Taken across the full population of the United States, non-adherence becomes a problem of enormous proportions. Given the already out of control costs related to healthcare, the focus should be on cutting unnecessary costs. Most of these costs are attributable to additional doctor visits, hospitalizations, and treatments that together add about $177 billion a year to the nation’s healthcare bill, according to the National Council on Patient Information & Education. Non-adherence also carries serious health consequences for a patients. For example, survival rates for kidney transplantation decreased by 5 years in non-adherent youth, with 71% of graft losses due to non-adher-
The issue of non-adherence has opened the opportunity for innovative solutions by medical technology companies. One of the most common attempts at reducing non-adherence is the use of pill organizers. Most often coming in the form of seven-day or month-long pillboxes in which the user manually loads pills (with some products also including automated dispensation features), these products help individuals to keep track of medications and simplify the complexity of drug regimens. An example is the plastic Apex Healthcare 7-day pillboxes, which help elderly patients with less technological experience organize their medication. However, the pillbox only organizes the medication in a better way; it doesn’t remind or encourage adherence for those that can already physically manage their medication. In a study measuring vitamin intake between patients with and without pillboxes, research found that patients with regular pillboxes did not exhibit significantly increased adherence rates compared to the control group. A more technologically savvy pillbox is AdhereTech’s pillbox that connects wirelessly to smartphones. These pillboxes look exactly like regular pill bottles; however, there is a sensor and an alarm installed so that medication dispensing can be tracked. The smartphone app allows digital tracking. Pillboxes are becoming more widespread as insurance companies have a financial incentive to promote or even mandate the use of pillboxes given insurance companies end up paying when patients both return to seek medical care and refill prescriptions most non-adherent patients will never use.

Other attempts at increasing adherence, from a tracking perspective, include medication management apps. Most often through a smartphone or web application, these utilities help individuals to create a schedule for managing medication intake. Pillpack is one of the many medication management apps. It differentiates itself by claiming to be analogous to a nurse, rather than an “alarm clock” tool that solely alerts individuals of non-adherence, and has applications for both smartphones and smartwatches. Like the personal care a nurse provides, Pillpack simulates this care through delivering medications to patient’s doors, and calling doctors when refills are needed. This could all be done through the apps as it allows the user to control medication times and deliveries. The fundamental reason why this implementation has not been effective and widely adopted is that it dismisses the fact that seniors have difficulty using technologies like smartphones. Due to a variety of factors, such as vision impairment and lack of knowledge or interest in technologically advanced devices, the elderly are much less likely to adopt such solutions. These apps are used primarily by middle-aged daughters and sons looking after their elderly parents. One of the most popular apps is Medisafe, which tracks medication progress. Because most people carry their phones with them, Medisafe is a great communication tool to use and stay on top of taking medications. For example, if a patient forgets to take their diabetes medication, the app user will receive an alert and can call the patient to remind them to take their required medication.

Innovation is crucial in the field of healthcare as our concept of health and what it means to deliver and manage quality healthcare is always changing. Due to the complexities of the healthcare industry, improving adherence to medication largely depends on the incentives of stakeholders in healthcare and existing policy. Factors such as payment models and drug delivery systems vary with insurance companies as well as physicians, making the industry much more difficult to pin down. Fortunately, the future of healthcare innovation offers many possibilities to entrepreneurs who are willing to invest in new projects that have the potential to improve lives.
At its peak in the 1940s and 1950s, polio paralyzed or killed nearly half a million people worldwide each year. Today, however, polio is nearly nonexistent due to Jonas Salk's discovery and development of the polio vaccine.¹ When several similar cases developed, the United States adopted and promoted individual entrepreneurship in pharmaceutical research to encourage such life-saving discoveries. However, these discoveries come at high costs. For example, an individual suffering from Hepatitis C must pay $84,000 for a 12-week treatment course. Yet, approximately 44% of all Hepatitis C cases within the United States occur among people of low socioeconomic status. At a cost of $1,000 per pill, the Hepatitis C drug, Sovaldi, which is not covered by Medicaid, is financially out of reach for these individuals.² With this in mind, it’s not hard to see that somewhere along the line pharmaceutical companies have created a monopoly. Patents, exploitation of the legal system, and small company acquisitions are three major factors that have contributed to this life-threatening issue.

The first tier of this apparent dilemma is the problem associated with patents, which grant the sole right to exclude others from making, using, or selling an invention. In the pharmaceutical industry, these patents typically last 20 years.³ When a company has an approved patent on a drug, because it is the sole owner of the drug, it can charge whatever price it deems fit, and other companies cannot copy its drug and sell it at a lower price. This system may still yield fairly priced drugs if the drug in consideration has functionally similar alternatives. However, many drugs that are critical to the survival of the patients do not currently have currently available alternatives. For example, Daraprim is an essential drug essential to people with HIV/AIDS patients with weakened immune systems because it prevents the contraction of infectious diseases in these individuals with weakened immune systems by inhibiting protozoan DNA and RNA synthesis.⁴ Immediately after Turing pharmaceuticals acquired patents for Daraprim in 2015, Martin Shkreli, the company’s CEO, raised the price of Daraprim from $13.50 per pill to $750 per pill overnight, representing over a 50-fold increase.

Prices were quickly lowered after much uproar highlighted in the media, but the price was only halved to $375 per pill.⁵ Although the price was reduced for Daraprim, a majority of pharmaceuticals do not undergo this same reduction in price. A similarly harrowing situation can be observed in the EpiPen market. Epinephrine Injections EpiPens are essential to people with severe allergies – when an individual has an allergic reaction, an EpiPen can save their life by sending epinephrine through the body, helping to open up airways that constricted due to the allergic reaction. Since the company Mylan NV has acquired the rights to the drug in 2007, the price per shot has increased from $50 in 2007 to $304 in 2017.⁶

Secondly, to make matters even worse, most large pharmaceutical companies exploit the legal system to extend the patents on their drugs. This area of pharmaceutical litigation revolves heavily around the Hatch-Waxman Act, which has drastically changed the industry since its introduction in 1984. This Act was put in place by Congress to extended patents for novel prescription drugs, allowing the innovator company to cover costs, with the hope that generics would be readily available when the patent expired. and with the motive of having readily available generics once the patent expired.⁷ However, it has secondary effects that allow big pharmaceutical companies to reverse its original intent. When a company's patent is nearing expiration, a generic company will file an Abbreviated New Drug Application (ANDA), which allows 180 days of market exclusivity starting from the day the company with the generic chooses to enter the market. Following this, the innovator company will sue the generic company, claiming that the generic infringes upon...
the company's technology. Thus, a court case follows in which the company manufacturing the generic has to litigate whether or not their drug infringes upon protected technology. In a majority of cases there is no infringement, but this process nonetheless allows for collusion. While the court case is on-going, the Food and Drug Administration (FDA) cannot approve any other generics under the Hatch-Waxman Act. During this time, as the court case proceeds, innovator companies often bribe the first generic company “under the table,” through cash or future benefits, in exchange for not entering the market. Even after the court case is over, regardless of whether there was infringement or not, the innovator company can still manipulate the market by continuing to pay off the same generic company. This creates a logjam, preventing other generics from entering the market and allowing the brand name company to extend its time as the sole price maker. As a result, large pharmaceutical companies can further their dominance of the market for their drugs, even though the drugs are no longer protected under patents.

Lastly, many large pharmaceutical companies actually spend very little on research and discovery of drugs compared to most people’s expectations because they acquire many smaller companies that created the drugs, instead of putting the money towards their own drug development. To understand how pharmaceutical companies spend so little on research and discovery, to date, all but three countries (the United States, New Zealand, and Brazil) forbid direct-to-consumer advertising of pharmaceuticals. This means that drugs created in most countries are much less profitable to the creator than they could potentially be because the companies have no means of advertising or expanding. Thus, a U.S-based company usually acquires the company that actually discovered the drug. It then patents the drug and markets it to consumers for huge profits, since it has become the sole maker of the drug. This is the case for most of the large shareholders in the U.S. pharmaceutical industry, such as Pfizer.

Despite these factors that contribute to monopolization in the pharmaceutical industry, it is important to also consider the perspective of the producers. Some pharmaceutical companies do spend significant amounts of their revenues on research and development and need to charge high prices while they have patent protection to generate profits and fund future studies. Regardless, companies, such as Mylan NV, generate astronomical profits, including over $1 billion per year from the EpiPen alone, when life-saving technology is at their pricing discretion.

Patents, maneuvering through loopholes in the U.S legal system, and acquisition of smaller international companies allow major U.S-based pharmaceutical companies to effectively create legal monopolies. With large sums of money, they are able to acquire many small companies with novel drugs, patent those drugs, create huge profits as the sole sellers, and extend the length for which they can be the sole sellers by navigating around current legislation. This vicious exploitation of defenseless consumers must be stopped.

The approach to pharmaceuticals and research, in terms of government regulation, has come a long way since its inception, but there are still necessary improvements to the industry. Although it may seem convenient to just completely abolish patents, it would not be sensible to do so because patents promote entrepreneurship, not just in medicine, but in all fields. Nonetheless, domestically, the U.S. government needs to do more to drive down the cost of pharmaceuticals. There are multiple avenues to do so. Policies could be implemented to reduce the length of pharmaceutical patents. This, in turn, would allow generic drugs to be created more quickly and would ideally drive cost down. Policies could also be implemented at the marketing stage to make direct-to-consumer advertising by pharmaceutical companies illegal. This would make the playing field for pharmaceutical companies across the globe more even, which can drive down the cost to the consumer. The most effective solution, perhaps, would be to remove the exclusivity received by the first generic to the market. This would allow the original brand name company to be the price maker for some time to cover their original costs, and at the same time, it would prevent collusion between big pharmaceutical companies and generic companies, allowing generics to flood the market once patents expire. By successfully driving down the cost of pharmaceuticals, people who cannot afford the Hepatitis-C treatment, Sovvaldi, priced at a towering $84,000 could alternatively purchase a generic or a price-regulated brand name and live their lives worry-free, along with the millions of others in similarly dire situations.
One morning late last year, Becky Jackson went to change her baby’s diaper. She laid Elizabeth, who was strangely mellow, onto the changing table, lifted her baby’s shirt, and discovered that what should have been a bulging belly, characteristic of a chubby six-month-old, had caved inward, exposing the outline of Elizabeth’s ribcage. Terrified by the sudden change in Elizabeth’s appearance and worried for her health, Becky took her to the pediatrician.1

Elizabeth’s blood tests were red-flagged for nearly every parameter – everything on the panel was either too high or too low. The pediatrician immediately sent Elizabeth to the Children’s Hospital in Omaha where she was labeled as a “failure to thrive,” a label often reserved for babies who have been abused or neglected. This was surprising because Becky took extra care to make sure that Elizabeth was healthy and well-nourished.

Becky did not have enough breast milk, so she used formula. Disappointed with commercial options, Becky found a recipe from a local health food store and gave Elizabeth the organic, homemade formula, using goat’s milk, coconut milk, and an assortment of liquid vitamins. What Becky had not realized was that her concern for her daughter’s health would backfire.

MIXED MESSAGES

In 2005, the National Health and Nutrition Examination Survey estimated that 77% of Americans had less than 30 ng/mL serum concentration of vitamin D in their blood, below the level sufficient for overall health. Health professionals have warned the American public of the vitamin D deficiency epidemic. Since, there has been an 83-fold increase in blood tests performed, and one in five Americans takes a vitamin D supplement.2

In the November 2016 issue of the New England Journal of Medicine (published after Elizabeth’s hospital stay), doctors instead warned that estimations of vitamin D deficiency are exaggerated – the cutoff for vitamin D’s serum concentration should be 20 ng/mL. In reality, fewer than six percent of Americans are deficient and only thirteen percent are at risk. The authors concluded, “these levels of deficiency do not constitute a pandemic”.3

ELIZABETH’S DIAGNOSIS

The image of Becky’s tiny baby hooked up to an IV and prodded for frequent blood draws for panel testing was heartbreaking. Becky noticed that, among the very skewed blood panel results, Elizabeth’s vitamin D and calcium levels were extremely high. Armed with symptoms and test results, Becky searched online and identified the cause: vitamin D toxicity. Sources of vitamin D can include sun exposure and diet, but the cause of vitamin D toxicity in most cases, including Elizabeth’s, is mega-doses of vitamin D.

“’I WAS VERY INNOCENTLY POISONING MY DAUGHTER.’”

Becky followed the baby formula recipe written down for her from the health food store exactly, except she thought there had to be a typo. “For every 32 ounces, it called for one drop of liquid vitamin D. Since all you hear is ‘You need vitamin D,’ I thought, ‘There’s no way this is right!’ I started to put an entire dropper (1 mL) in with the formula instead of just one drop.” She now admits, “I was very innocently poisoning my daughter.” She was giving Elizabeth 8,000 times the amount of vitamin D she needed.

QUESTIONING THE INDUSTRY

Fortunately, Elizabeth appears to have made a full recover. After Becky’s experience, she no longer gives Elizabeth any supplements because she trusts that she can get the nutrients from her diet. Becky made a mistake, but in her readiness to add vitamins to her baby’s formula, she wasn’t behaving very differently from the millions of Americans who swallow vitamins each day with little understanding of how they work or whether they need them. In most cases, this trend appears to be harmless, but stories like Becky’s reveal that we need to be more informed about what we are putting into our bodies.

Vitamin supplements often contain more than 100% of their recommended daily value. There are no set standards or regulations for vitamin and mineral supplements. In some cases, the vitamins and minerals in a supplement may be at levels higher than our bodies can tolerate, which can have lethal consequences.4 Are we innocently poisoning ourselves? How much is too much of a good thing?

THE ANSWERS

People take daily micronutrient supplements not only to prevent deficiencies but also because they appear to confer addition-
al benefits, like preventing cancer. However, at the end of 2008, the SELECT (Selenium and Vitamin E Cancer Prevention Trial) study came to a screeching halt, three years before it was originally set to conclude. With five years of research, two troubling trends emerged: there were more cases of diabetes among men taking only selenium and more cases of prostate cancer among the men taking only vitamin E.3

While the increases were not considered statistically significant, researchers determined that the lack of any benefit, in addition to the potential risks, were strong reasons to end the SELECT study. In response to SELECT’s findings, Dr. Marc Garnick of Harvard Medical School provided the concerned public with a decisive statement: “There is no evidence that multivitamins prevent cancer, heart disease, or any other illnesses.”

Following the surprising results of the SELECT trial, similar studies were performed. The goal of one 2004 study was to determine whether antioxidant supplements decrease the occurrence of gastrointestinal cancers and mortality by compiling the records of 68 randomized trials involving vitamin A, vitamin C, vitamin E, beta carotene, and selenium with a total of 232,606 participants. Researchers could not find any evidence that antioxidant supplements prevent gastrointestinal cancers and noticed that they actually seemed to increase overall mortality.6

A French study conducted in 2007 aimed to test whether antioxidant supplements and minerals prevent skin cancers. The research showed a statistically significant increase in incidence of skin cancers among women who took the antioxidant supplements rather than the placebo. Researchers made two conjectures regarding their counterintuitive findings. Firstly, the participants were all adults, and they suspected that by that time, it might be too late for antioxidants to prevent any cancer-causing DNA damage caused by sun exposure. Second, to explain the negative effect, they considered that antioxidants may interfere with the ability of natural killer lymphocytes to destroy tumor cells. That is, antioxidants might be blocking our natural defenses against illness.7

The Women’s Health Study, published in 2011, examined the relationship between supplement use (specifically, multivitamins, vitamin B6, vitamin B9, iron, magnesium, and copper) on post-menopausal women and total mortality rate. The study showed risk increases between 2.4 and 18.0% with supplements. The researcher considered the possibility that iron might catalyze oxidation to promote oxidative stress. They concluded that, “Based on existing evidence, we see little justification for the general and widespread use of dietary supplements. We recommend that they be used with strong medically based cause, such as symptomatic nutrient deficiency disease”.8

A study conducted in 2011, examined the relationship between supplement use on overall health – have yet to be proven, while the evidence that they cause harm is extensive and strong. There is ultimately no need for supplements unless your doctor has determined that you have a deficiency or that you are at risk for a deficiency. You, as a responsible consumer, should question the micronutrient supplement industry. Ask your doctor before blindly adding supplements to your diet.

References
It has long been established that wealthy individuals generally live longer than the poor. However, despite recent advances in medicine, technology, and education that are increasing life expectancies in the United States as a whole, the gap between life expectancies of high-income and low-income Americans has been widening. In the early 1970s, a 60-year-old man with an income in the top fifty percent had a life expectancy 1.2 years longer than a man of the same age in the bottom fifty percent; by 2001, however, this difference in life expectancies increased to 5.8 years. Similarly, life expectancy for the bottom ten percent of wage earners increased by three percent for men born in 1950 compared with men born in 1920 but increased by a much greater 28 percent for those in top ten percent.1

Beyond gaps in life expectancy, income inequality itself has grown in the country’s largest cities within the last ten years.2 While life expectancy is certainly tied to income inequality, income does not single-handedly determine life expectancy disparities. New York City and Philadelphia clearly demonstrate this relationship. New York City has a greater income gap than Philadelphia - New York City’s wealthiest residents (95th percentile of income, $226,675) make 13.2 times as much as the city’s poorest residents (20th percentile, $17,119), while Philadelphia’s wealthiest residents ($151,026) make 11.8 times as much as the poorest ($12,850). Of the fifty largest United States cities, New York City has the sixth highest rate of income inequality, and Philadelphia has the twelfth highest.2

However, despite New York City’s very large wealth gap, the city has one of the smallest life expectancy gaps in the nation. Impoverished New Yorkers tend to live much longer than impoverished residents of other cities. Although impoverished New Yorkers still die younger than wealthier residents, the life expectancy gap is smaller in New York City than nearly anywhere else and has declined since 2001, despite gaps growing nationwide. Of the one hundred largest commuting zones (groups of adjacent counties defined by commuting patterns) by population, New York City has the highest life expectancies at age 40 for residents in the bottom income quartile (81.8 years overall, 79.5 years for men, 84 years for women). Philadelphia, on the other hand, is ranked 70th of the 100 largest commuting zones, with a life expectancy of 78.7 years for its bottom quartile residents (76.1 years for men, 81.4 years for women).3

In order to determine why poor New Yorkers fare better than poor Philadelphians, the behavioral, demographic, and structural health factors were compared in the neighborhoods with the highest poverty levels in each city. In New York City, the selected areas were United Hospital Fund (UHF) neighborhoods 105 and 107 in the Bronx, Crotona-Tremont and Hunts Point-Mott Haven, with 40.76 percent and 41.69 percent of the population, respectively, with annual incomes below 100 percent of the federal poverty line.4 In Philadelphia, the selected neighborhoods were the Lower North and North planning districts, with poverty levels...
of 46.9 percent and 46 percent, respectively. The Philadelphia districts have life expectancies at birth of approximately 71 and 72.6 years. New York City does not measure life expectancy by UHF neighborhood, but life expectancies measured by community district can provide an approximation. The Hunts Point-Mott Haven UHF neighborhood can be approximated by the combination of the Hunts Point-Longwood district, with a life expectancy of 77.6 years, and the Mott Haven-Melrose community district, which has a life expectancy of 76.1 years; the Crotona-Tremont UHF neighborhood can be approximated by the Fordham-University Heights and the Belmont-East Tremont districts, with life expectancies of 78.9 and 76.7 years, respectively.

Hunts Point-Mott Haven and Crotona-Tremont have lower mortality rates for many leading causes of death and lower prevalences of many health indicators and behavioral factors as compared to Lower North and North Philadelphia. Factors such as cancer, heart disease, chronic lower respiratory diseases, accidents, homicide, and HIV, among others, contribute to substantial differences between New York City and Philadelphia high-poverty neighborhoods. These differences may be attributed to smoking and health screenings, as well as other behavioral, demographic, and structural differences such as foreign-born population, income, access to care, and government spending on health and social services.

New York City has done considerably more to combat smoking, excessive drinking, cancer screenings shortages, HIV, and health disparities as a whole than Philadelphia has. Philadelphia may therefore want to consider implementing programs similar to those of New York City in these areas to achieve similar reductions in disparities. Specifically, higher cigarette prices and taxes, ad campaigns warning against the dangers of excessive drinking, campaigns for awareness and assistance in receiving health screenings, especially colonoscopies, and initiatives and ad campaigns created specifically to encourage HIV testing may be worth trying, as they were noticeably lacking from Philadelphia’s set of programs, while likely contributing to New York City’s diminished disparities. In addition, the creation of an entity to focus on initiatives specifically to help the poorest neighborhoods in Philadelphia and to directly combat health disparities would likely prove useful for Lower North and North Philadelphia, as well as for Philadelphia as a whole. While noticeably absent from Philadelphia’s policies and programs, New York City emphasizes this type of program through its District Public Health Offices, which “work to promote health equity and reduce health disparities across New York City by targeting resources, programs, and attention to high-need neighborhoods.” The Bronx DPHO, one of three DPHOs in the city, directly serves the Hunts Point-Mott Haven and Crotona-Tremont neighborhoods. As the goal is to directly help the poorest neighborhoods and eliminate health disparities, this program seems to be a likely source for much of the discrepancy between the outcomes in Hunts Point-Mott Haven/Crotona-Tremont and Lower North/North Philadelphia.

Furthermore, New York City’s Center for Health Equity, Neighborhood Health Action Centers, Building Healthy Communities initiative, OneNYC plan, and Take Care New York 2020 plan are similarly designed to specifically reduce health disparities. Philadelphia, on the other hand, has focused its efforts largely on improving health citywide, rather than emphasizing the needs of the highest-poverty neighborhoods and reducing health disparities. Given that despite its large wealth gap, New York City maintains a much smaller life expectancy gap than Philadelphia, it is clear that factors beyond income play a role in health and life expectancy. Cities can implement policies to improve health, decrease mortality, and increase life expectancies. Philadelphia has implemented many programs to improve the health of its residents and has found some success. However, the progress in New York City shows that there is much more work to be done to reduce, and ultimately, eliminate health and life expectancy disparities between the rich and poor in Philadelphia. As Dr. Thomas Frieden, the director of the CDC, explains, “There is a very strong correlation between income and life span. But it is not inevitable. There are things we can do to change the life trajectory of people."

References
Health disparities in the United States are a product of many aspects of healthcare. That being said, an argument arises: is healthcare a right or a privilege? Regardless of what it is labeled, almost everyone will need access to healthcare at one time or another throughout the course of their life; however, not everyone in need is awarded the same reach of care. One concern facing inequality in the United States in recent times is the issue of mental health. Though treatment and the stigma surrounding these conditions is improving significantly overall, there is a considerable disparity between major ethnic groups in the United States in the treatment they receive. In fact, according to the International Journal of Health Services, “one in five Americans are estimated to have a mental illness at any given time,” but the situation is more dire for minorities, as “Black and Hispanic children saw someone for treatment far less often than did their white counterparts - about 130 fewer visits per thousand subjects. Black young adults visited a mental health specialist about 280 fewer visits per thousand; Hispanics 244 fewer visits.” By using one established public health tool, and in turn considering two confounding variables related to the study of health disparities, the issue becomes easier to digest.

DEMOGRAPHICS INCLUDED IN THE EIGHT AMERICAS

Health disparities in the United States are dramatic, pervasive, and nearly impossible to fully understand. Epidemiologists, historians, economists, sociologists, anthropologists, physicians, and public health officials have long sought to explain how and why socioeconomic status, race, and environment contribute to health outcomes. With hopes of ultimately closing disparities and improving health, scholars have attempted to simplify the complex web of health disparities with theoretical framing tools. Professor Christopher Murray introduced one such tool, “The Eight Americas,” in his report Eight Americas: Investigating Mortality Disparities across Races, Counties, and Race-Counties in the United States. In this report, Murray suggests that scholars conceptualize Americans in eight subgroups: Asian, Northland low-income rural White, Middle America, low income Whites in Appalachia and the Mississippi Valley, Western Native American, Black Middle America, Southern low-income rural Black, and High-risk Urban Black. The system coined by Murray categorizes Americans into discrete subgroups based on geographic location, socioeconomic status, and race, within which health tends to follow similar patterns.

ONE IN FIVE AMERICANS ARE ESTIMATED TO HAVE A MENTAL ILLNESS AT ANY GIVEN TIME.

EDUCATION AND HEALTH

Societal divisions offer one explanation for disparities in health. Division originates from numerous aspects of society, one of which is the monumental rift in the educational attainment of each group. Data from the 2015 Current Population Survey (CPS) show that there is a considerable difference in college education among Asians, non-Hispanic Whites, and Blacks. The difference between Asians and African Americans (the highest and lowest subgroups) is a margin of 17.1 percent. These statistics correspond with the health of each of these groups, as Asians and White Middle America have a life expectancy at birth of <80 and 75 years, respectively, and Black Middle America has a life expectancy at birth of 70 years.
It is possible that such a correlation exists due to the knowledge and opportunities that an education provides. Family physician and associate professor at the Keck School of Medicine of the University of Southern California, Jo Marie Reilly explains this by saying “It’s all those things that education allows you to have” which lead to a healthy lifestyle. These “things” include resources such as healthier foods, access to safe parks, and recreation centers for exercise. The inverse relationship between education level and rates of poor health such as infant mortality can be explained by the experience that one gains with an education: eleven percent more of whites in the US than blacks have a college degree, and coincidentally also happen to experience half of the infant deaths. Those that have 4 years in a college environment are through experience, more likely to be aware of the risks of poor health habits and how to live the necessary type of lifestyle to prevent frequent, easily treatable diseases. Through the division of subgroups made by Professor Murray’s study, it can be more clearly seen how a factor such as education more severely impacts some groups’ health outcomes, as opposed to others.

INCOME AND HEALTH

A second factor that may affect the divergence of health between subgroups is the average income per capita for each race. According to Murray’s “Eight Americas” report, the average Asian in the United States earns approximately 21,5000 dollars per year, while White Middle America and Black Middle America sit at 24,500 dollars and 15,000 dollars, respectively. The general trend stays the same; those groups with higher rates of college education also experience a higher average income. In America’s capitalist economy, money often leads to accessibility. Generally low income demographics such as Hispanics and Blacks in the United States experience poor health more than relatively well off groups such as Asians and Caucasians. Those in the top five percent of the income bracket ($50,000+ a year) have 25 percent longer life expectancies than those at the bottom. The difference in income makes a notable difference in the ability to stay healthy, and some factors responsible for this are the advantages that a higher disposable income brings with it. Many people live paycheck to paycheck, and this leads to a lack of responsibility regarding if food is organic or good for one’s health, instead placing emphasis on putting any form of sustenance on the table for the family. Quality of food is one such factor that mediates the relationship between income level and health. The variability in income between individuals of different racial groups can also contribute to factors such as living conditions and transportation, which snowball into differing health coverage.

IT’S TIME FOR ACTION

In the 2014 Commonwealth Fund Survey, the United States fell behind in comparison to nine other countries in health-related factors such as quality of care, access to doctors and yes, equity throughout the country. Minorities who are a part of older generations have been subject to unequal conditions for their whole lives, and it seems like things are not changing as much as they should be- so what needs to be done? It just so happens that the Surgeon General, Dr. Vivek Murthy, may have a plan; some of his most important recommendations include: standardizing and collecting data to better identify and address disparities, supporting research to identify effective strategies to eliminate health disparities, and offering preventive services (e.g., mental health services, oral care, vision, and hearing screenings) for all children, especially those at risk. Health disparities in the past have had a bleak outlook, yet by following the careful recommendations that are listed, and through action led by families, schools, and even businesses which hire, the gaps in health between ethnic groups can improve greatly in the United States.

References

Rethinking an All-Nighter

The cost of sleep deprivation

BY VICTORIA SIU

In the 2013-2014 academic year, one out of every three Penn students reported lack of sleep as a negative impact on their grades.6 Balancing a full schedule of classes and extracurriculars, students from Penn’s campus sleep on average only 6.7 hours per day⁶ - a number below the National Sleep Foundation’s recommended range of 7-9 hours.⁶

“[Sleep awareness] is obviously very underemphasized,” said College sophomore Cole Purdy. “Everyone gets by on a work-hard-play-hard philosophy. They think sacrificing sleep every week is a sustainable lifestyle, when it’s really not.”

While we spend a significant extent of our lifetime in sleep, the function of the state remains mostly unknown.⁵ Perhaps the ambiguity behind the purpose of sleep may contribute to a trend of people underestimating the effects of sleep deprivation and its frequency among Penn students.⁵ Although the purpose and mechanisms of sleep have yet to be fully unraveled, current studies indicate a strong link among sleep, memory consolidation, and general well-being.

THEY THINK SACRIFICING SLEEP EVERY WEEK IS SUSTAINABLE, WHEN IT’S REALLY NOT.

To understand the scale at which sleep deprivation affects the human body, we must follow sleep deprivation research back to its beginnings. In 1960, Morris et al. was one of the earliest human studies to report the effects of sleep and sleep deprivation on temporal and declarative encoding, in which temporal encoding is defined as memory for when events occur, while declarative encoding is defined as recall memory.⁵ Morris et al. found that after a night of pre-training sleep loss, temporal memory was significantly disrupted.⁵ The paper sparked additional studies that resurfaced in 2000 when Harrison and Home had participants undergo a similar training and testing paradigm. They found significant impairments in retention and performance for temporal memory in subjects deprived of sleep for 36 hours and even when a subgroup received caffeine.⁵ As technology improved in the 21st century, positron emission tomography (PET) scanning provided snapshots of the role sleep plays in human brains learning to navigate a virtual maze task.⁵ Activity in the hippocampus associated with daytime learning was later reactivated during post-training slow wave sleep (SWS). In addition, Peigneux et al. pointed out that the amount of hippocampal reactivation indicated in the PET scans was proportional to the amount of learning improvement the next day, implying that this reactivation is associated with learning during sleep.⁵ In recent years, a pattern of association between clinical mood disorders and sleep loss has indicated the possibility of sleep’s role in emotional regulation.⁵ Thorough investigation and the improvement of scanning technologies suggest that sleep plays a significant role in memory encoding, memory consolidation, brain plasticity, and possibly mood.¹² Through the years, research has been building toward a conclusion that without sufficient sleep, hippocampal activity becomes disrupted, altering encoding dynamics in the prefrontal region and causing a decreased ability to form new memories.³

Memory consolidation describes the process in which new memories formed in the hippocampus during the awake-cycle are transformed and connected to the network of long term memory in the prefrontal cortex.² This type of plasticity has been observed to occur most effectively during sleep. Research has proposed different mechanisms of the neural activity and memory consolidation process during sleep. Two models of sleep-dependent plasticity have risen as main contenders to explain the overnight facilitation of recall: synaptic homeostasis hypothesis and active system consolidation hypothesis. The synaptic homeostasis hypothesis assumes memory consolidation as a by-product of pruning and downscaling synaptic connections throughout the brain during sleep. The active system consolidation hypothesis proposes re-activation of select memories during sleep as the mechanism behind consolidation.³ While research lacks evidence in the synaptic homeostasis hypothesis for how neuronal activity during SWS would induce synaptic downscaling, both hypotheses
activity during SWS would induce synaptic downscaling, both hypotheses are not mutually exclusive. A combination of mechanisms may better explain how memory is consolidated during sleep.² 

Despite the new understandings in sleep function, daytime sleepiness, sleep deprivation, and irregular sleep schedules remain vastly prevalent among college students.² According to Student Health Services, students across different campuses attribute academic stress as the leading cause behind sleep deprivation.⁶ Public Health Specialist Rebecca Huxta says students often misinterpret sleep as wasted time, which causes them to compromise sleep when they need extra time to study.

“Memories are created by sleeping, dreaming, and going through sleep cycles,” Huxta said. “And students don’t realize you need sleep for memory retention, so they’ll often stay up all night studying and can’t retain any of that information.”

The National College Health Assessment indicates that sleep deficit follows stress and anxiety as the largest contributors to poor academic performance. Consequences in sleep deprivation show themselves in the form of lower grade point averages, increased risk of academic failure, and compromised learning.⁷ In a cognitive memorization task, subjects who were partially sleep-deprived by receiving 5 hours sleep (compared to the national recommendation of 7 hours) performed worse than subjects with short-term and long-term sleep-deprivation.¹ 

But the symptoms resulting from sleep deprivation goes beyond academia. Amanda Swain, MD, a physician specializing in sleep disorders at Student Health Services, sees cases encompassing mental health, lifestyle, and substance abuse.

“It runs across a wide spectrum,” Dr. Swain said. “Anything from increased risk of mood issues, mild depression, making underlying anxiety or depression worse, to things like difficulty maintaining concentration, taking longer to do tasks, difficulty in more complex functioning. It also puts students at risk of abusing substances like alcohol or marijuana.”³

Supporting Dr. Swain’s statement on how mental health and sleep are closely related, a study of female college students associated sleep debt of 2 hours per night and/or bedtime after 2 AM with greater depressive symptoms.⁷ An extended sleep latency was associated with loss of pleasure, feeling of punishment, and self-hatred.⁷

The issue of sleep deprivation on campus became apparent from survey results from the biannual National College Health Assessment through Penn’s participation with the American College Health Association. In response to the data, Student Health Services started the Sleep Well initiative in 2014. Focusing on health education and promotion, Sleep Well offers podcasts that help with meditation as well as workshops that inform students on sleep hygiene and architecture. In addition, the Sleep Well initiative also distributes free sleep kits distributed at Student Health Services and the Sleep Well workshops. Huxta explains the purpose of the sleep kits is to focus on quality of sleep rather than quantity because students at Penn have a history of inconsistent sleep schedules.

“Students just aren’t getting [the National Sleep Foundation’s recommended hours of sleep] here,” Huxta said. “Instead of focusing on that number of sleep, if you are getting minimal amount of sleep, we want it to be a good quality of sleep so that you can be well rested.”

Focused on improving the quality of sleep, the Sleep Well initiative offers lifestyle tips to students such as switching to the Night Shift mode for iPhones or downloading a red-light app for other smartphones near bedtime. The blue light emitted from laptop and phone screens tricks the brain’s circadian rhythm into assuming it is still daylight. In addition, Sleep Well advises students to exercise at least four hours before sleeping. Exercise leads to increase in body temperature, which may take hours for the body to regulate to a lower temperature optimal for sleep.

Although the Sleep Well initiative is a relatively new program for Student Health Services, attitudes across campus have already begun to change. An increasing number of College House deans and schools are requesting sleep workshops, and Student Health Services often set up Sleep Well information booths during school-sponsored study breaks.

While we have come a long way both in terms of sleep research and public awareness of sleep deprivation, as high achieving individuals, we must learn to balance our physical limitations with our ambitions. Sleeping 6.7 hours a night may help squeeze in an extra hour of Netflix or Organic Chemistry, however there are still consequences to the actions we take. By promoting further dialogue in sleep awareness from both student and campus organizations alike, we can improve our lifestyles.
Over the past few decades, the topic of mental health on college campuses has progressed from a heavily stigmatized topic to one of the most widely discussed issues in the country. A survey by the American Psychological Association in 2013 found that 41.6% of college students suffer from anxiety, and 36.4% from depression. Data from the National Alliance of Mental Illness reports that 50% of students rate their mental health to be average or poor and 1 in every 4 students have suicidal thoughts or feelings. The questions we need to ask are as follows: Why has mental health become such an epidemic on college campuses and how can we address this issue?

The causes of poor mental health vary on a case-to-case basis, but a few reasons are more prevailing than others. Firstly, enhanced academic stress has been found to cause anxiety, depression, and other mental health problems. Managing time effectively and engaging in leisure activities can help prevent compromised mental health since the absence of those factors are often predictors of academic stress.¹ Time management refers to “clusters of behavior that are deemed to facilitate productivity and alleviate stress”.² It is a difficult skill to acquire, especially for students who have to learn to juggle extracurriculars and a social life along with academics. Their academics may be affected due to other activities, thus increasing their stress and having a negative impact on their mental health. Leisure satisfaction is defined as “the positive feeling of contentment one perceives as a result of meeting personal needs through leisure activities”.³ This may include playing a sport, taking a vacation or spending time with friends. These activities distract students and consequently help reduce the stress they feel.

If academic stress and time management are issues almost every college student faces, why does mental health not have a larger presence on campuses? The Social Comparison Theory, proposed by the social psychologist Leon Festinger in 1954, can provide an explanation for this. His theory states that individuals tend to compare themselves and their skillsets to those of others as a means of analyzing their own. A subset of this theory is Upward Comparison, which refers to an individual’s inclination to compare his or herself with someone more accomplished or “better” than one’s own self.⁴ For example, research has indicated that women frequently make appearance-related social comparisons, which may relate to body dissatisfaction, low self-esteem and in severe cases, depression.⁵ Upward Comparison predominates on college campuses, and it is the root of the inferiority complexes that sprout up. Students do not want to seem vulnerable to their peers by expressing their struggles, and so they put up a front which belies the stress or trouble they’re facing. This phenomenon is referred to the infamous Penn Face at Penn, and as the Duck Syndrome in Stanford University—the sufferer looks completely calm on a superficial level as a duck does when it glides on the water surface, but in reality the person struggles frantically, just as a duck frantically moves its feet underwater to keep swimming.⁶ The paradox that arises is that most people put up a seemingly happy "Penn Face", but they fail to recognize other people doing the same. Hence, they look around and see how in control their peers are of their lives, and they wonder why they’re the ones suffering. This paradox came into light when Penn freshman, Madison Holleran, took her own life in January 2014. Her death surprised many people who knew her, because she was believed to be a happy, accomplished and popular student.⁷

A third reason for this phenomenon is that there are social stigmas associated with poor mental health. Fortunately, college campuses have come a long way from ostracizing students with such issues to being significantly more accepting over the past decade. However, students would still rather put up a brave front, such as wearing a “Penn Face”, than express their vulnerability. Students tend to have an exaggerated view of public stigma, which leads them to believe that they will fall into a certain negative stereotype and be discriminated against. In reality, it is usually personal stigma, or one’s own perception of mental health, that bars them from seeking help.⁸ Keeping these and other issues in mind, there has been a remarkable increase in the facilities offering mental health services in colleges. Decades ago, student health services would target only the sick and injured, but now there are separate centers that cater

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Admittedly, there is still room for improvement with respect to college mental health centers. Complaints arise that the waiting rooms at such centers are open spaces, and so they are not confidential. At times, students are not given appointments with a therapist until two weeks after they request help if their situation is deemed to be not urgent. For example, at the University of Washington in Seattle, delays in getting counseling are so routine that the wait time is posted online. Smaller schools are no exception—at Carleton College, the wait list can stretch up to 10 days. The low access to these services is also a deterrent for some students. At Penn, CAPS is located about a fifteen-minute walk from the heart of campus, so it is a significant detour that most students would rather not take. These centers need to be located closer to the campuses and a larger staff needs to be employed to cater to more students at a given time. Confidentiality issues need to be addressed so students feel more comfortable seeking help.

It is difficult for colleges to eradicate academic stress amongst students while still breeding a healthy, competitive environment. Colleges are making efforts to alleviate the stress, however, through different strategies. At some schools, such as MIT, students are not assigned a GPA for their first semester so that they can explore their interests and assimilate to the school. To give students the room to experiment with classes and be able to take on manageable workload, most schools give students around 3 weeks into the semester to drop a class. In the event that a student realizes mid-semester that the academic workload and stress has skyrocketed, he or she can withdraw from a course as well. Although the intention behind these actions is to ensure students can work with a manageable course load, it is understandable that many students do not avail themselves to these actions. This is because many students have so many college requirements to fulfill that they can not drop a class if they wish to graduate on time. Additionally, a withdrawal shows up on one’s transcript, so students are afraid of tainting their transcripts with one. Colleges need to encourage students to drop or withdraw from a class if it would make a significant improvement to their mental health and the repercussions of doing so need to be less permanent than something that stays on their transcripts.

For all these improvements to be made, colleges need to allocate more resources to mental health. In addition, a more receptive environment needs to be bred to encourage students to utilize the services offered by their schools. It is only when students feel comfortable confronting their issues that they will seek help, and for that to happen they need to be ensured that they are not going to be discriminated against or ostracized for what they are going through.

References