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ABOUT EUMR

Mission Statement:

The Emory Undergraduate Medical Review is for Emory undergraduates interested in medical or health related careers to engage in scholarly discourse with their peers and medical professionals. EUMR publishes semesterly hard-copy and online copy journals in addition to smaller newsletters published throughout each semester. Each semesterly issue primarily features reviews on interesting and cutting-edge topics in the medicine, and medical opinion articles are also welcomed. All semesterly review pieces are reviewed by MDs/PhDs featured on our advisory board that are from institutions around the country. Newsletters feature more succinct and accessible pieces in recurring sections including ethics, biotechnology, Public Health, Nutrition, and more. EUMR also endeavors to put on educational events relevant to students interested in medical or health careers.

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Dr. Michael Crutcher, PhD
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Michael D. Crutcher

Dr. Michael Crutcher is one of the many distinguished faculty members part of Emory's Neuroscience and Behavioral Biology department. Having received his PhD in Physiology from Johns Hopkins University, he joined the Department of Neurology and of the Neuroscience Ph.D. program at Emory in 1991. His research is primarily focused on the neural mechanisms of visually guided reaching movements in monkeys.

Dr. Crutcher has taught many NBB courses over the years such as: freshman seminar courses (NBB 190) on Brain Enhancement, Curiosities of Neurology and Neuroscience, and Neuroethics as well as Perspectives in Neuroscience and Behavioral Biology (NBB 401 SWR), Biology of Movement Control (NBB 370), Neuroscience Research Methods (NBB 221), Functional Neuroanatomy (NBB 470), and Topics in Neuroscience and Behavioral Biology (NBB 270).

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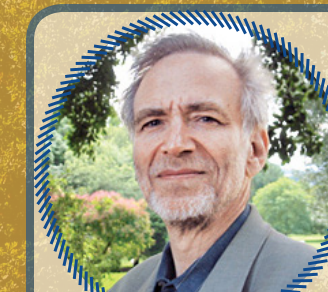


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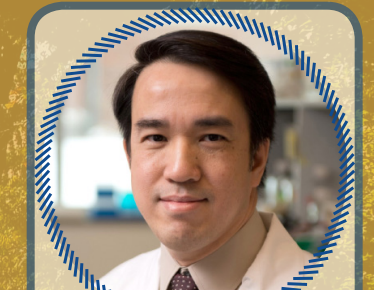
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EUMR FEATURE: CAPSTONE ARTICLE FROM THE PRESIDENT

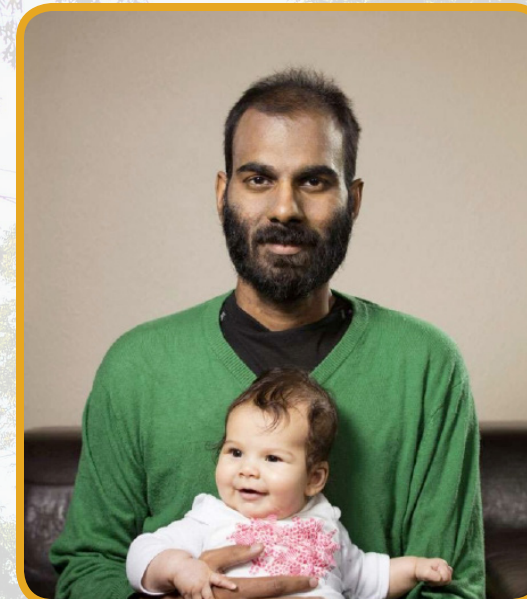


Humanizing the (Future) Physician

Written by: Somnath Das
Edited by: Alec Shannon
Reviewed by: Dr. Laura Otis

Capstone articles are pieces written by the President of the Emory Undergraduate Medical Review either during the Fall or Spring edition. These articles aim to be a thorough synthesis of their primary interest in medicine, with the purpose of communicating the need to look at the field from different perspectives.

In May of 2013, Dr. Paul Kalanithi was diagnosed with Stage IV metastatic lung cancer. A relatively young man, Kalanithi could not have received this news at a worse time. He was completing his training as a neurosurgery resident, and additionally, had to experience the first moments of his daughter's life just as he was experiencing the last moments of his own. In his memoir, *When Breath Becomes Air*, Kalanithi offers his readers the narrative of his illness, providing a powerful example of the necessity of reflecting on death and dying. In 2015, Paul Kalanithi passed away, and his memoir was posthumously published.



Dr. Paul Kalanithi

In this novel, Kalanithi provides not only the story of his illness, but also he discusses his own emotional reaction to the progression of his disease. During his last day as a neurosurgery resident, he received news his brain tumor had re-appeared, metastasizing on his brain. He writes, "Going back to the old images, I could make out the faintest trace of it, a ghostly harbinger now brought fully into the world. I was neither angry nor scared. It simply was. It was a fact about the world, like the distance from the sun to the Earth." There is a crude irony in that his last day as a resident is also one of his last days as a physician; yet, we see Dr. Kalanithi maintain a calm state as he reacts to the story of his disease, and these emotions are elucidated through his use of metaphor throughout his narrative. Thus, the value of Dr. Kalanithi's memoir is that we can observe one of the many ways a person can react to and process their experience of disease, and additionally how they share that reaction with others.

There is a great power in the structure of narrative. We can define narrative as the practice of reading, writing, telling, and understanding stories. Narrative theory assumes that narrative is the most fundamental method by which humans process and tell about their experiences; in the context of narrative

theory, we can assume that patients tell about their states of health and illness using narrative. My most significant as a pre-medical student originated from stories of patients, my professors, and closest friends. Reading the stories of others, such as Dr. Kalanithi's, pushed me to think about the process of death and dying for the first time as a student. The ability to appreciate and internalize the intricate details of narrative is imperative for clinical training, and one can begin this practice by understanding and analyzing literature in the humanities. A keen ear to the field of ethics, for example, allows us to integrate individual patient perspectives into a larger picture of human rights as we debate the role of growing technologies in patient care. Studying art, too, can help medical students become increasingly acute observers (Naghshineh et al. 2008).

"Accessing the humanities gives us the ability to understand, and more importantly appreciate the value of patient narratives."

But what more can a budding medical student learn by studying narrative, and more broadly, the humanities? What factors enabled Dr. Kalanithi to reflect on his own dying, even as he was attempting to heal others? There are more than enough case studies in medicine to provoke a debate over providing care versus cure. As future physicians, students can only hope to imagine the nature of this vast discussion that affects healthcare professionals and patients alike. Can the humanities teach us more?

Medicine's ability to provide cure and the history of this ability are often what pre-medical students are exposed to in the classroom. Curricula are designed to promote the learning of basic science and problem-solving skills. Medical care suffers immensely during this trajectory if the budding pre-medical student fails to pursue significant education outside of the hard sciences. This phenomenon is illustrated by simple statistics: a study by Rhoades, McFarland, Finch, & Johnson (2001) found that it took an average of 12 seconds for a patient to be interrupted by a resident when speaking. Computer usage, more than disturbances such as beepers, was the most common type of distraction. While the numerical statistic may have changed, the universal truth behind this number, 12 seconds, is certainly the same. Therefore, medical curricula are still at great need for change, and that change could begin right now by integrating humanities education into medical training.

Accessing the humanities gives us the ability to understand, and more importantly appreciate the value of patient narratives. Dr. Paul Farmer, a noted figure in global health, studied ethnography's intersection with medicine when he sought to provide care to the people of Haiti by establishing Partners in Health. Tracy Kidder in his biography of Dr.

Paul Farmer, *Mountains Beyond Mountains*, wrote extensively about Dr. Farmer's dedication to learning the languages, values, and beliefs of the people he served. This intensive study of anthropology enabled Dr. Farmer to address the Haitian people with dignity and respect as he treated a population known to be distrustful of modern medicine due to its religious beliefs. Emory's very own Dr. Melvin Konner extensively documented the livelihoods of the Kung San people, an isolated population in Africa. His findings and observations helped to clarify and illuminate the evolution of human behavioral biology, allowing us to comparatively map the behaviors of our ancestors in relation to our own.

But, one does not need to travel abroad in order to appreciate the skills Dr. Farmer and Dr. Konner practiced. One can listen to stories in local places like hospitals, coffee-shops, and schools. That said, there is additional training required to be able to extrapolate meaning from narrative. Connecting to patients via absorbing their narrative over long periods of close contact can give the physician a perspective on that person's biology that scrawls on a chart sometimes cannot provide (Charon, 2006). These connections are entirely dependent on the physician's ability to understand various patient qualities such as ambiguity in memory, differences in cultural perceptions of medicine, and potential for disagreement. Thus, there is a large human component to medicine. To master this essential part of clinical practice, the future physician must receive significant training in what it means to experience a story of illness, and this understanding's foundations are first laid by studying emotion.

Sources of emotional understanding can be found within the literature of both the sciences and the humanities. Neuroscience education allows for

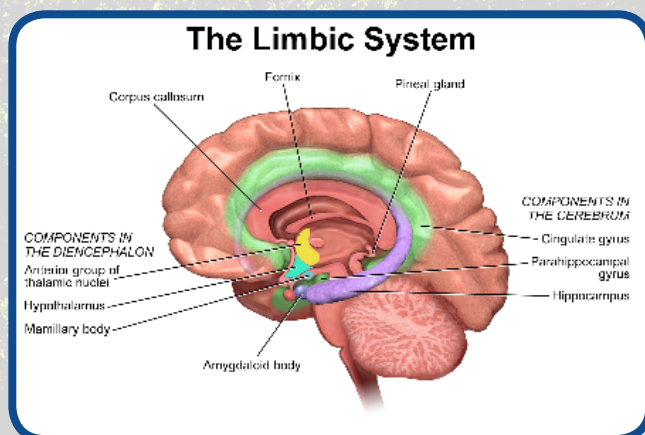


Figure 2. Neuroscience studies the integration of emotions with structural biology. Pictured here is "the emotional brain."

the integration of structural biology with observed behaviors. Reading creative literature helps one see what emotion looks like in vivo and how we can put emotions into words via literary devices. Dr. Kalanithi, for example, received a Master's in English prior to

practicing medicine. Dr. Farmer and Dr. Konner received extensive training in anthropology while practicing as physicians. Studying stories allows us to visualize the bridge between human emotional states and human actions. Understanding who the narrator is, who the observer is, and the emotional reactions of all involved as the story is unfolding is a skill of great value for the development of future physicians. While scientific studies generalize universal behaviors from multiple samples, physicians should study the humanities in order to extrapolate universal lessons about human behavior from singular narratives.

The nakedness of the deep emotional interaction can at times be frightening and difficult for the budding physician. Science has engrained within us the belief that excess emotion leads to mistakes, rash decisions, and uncertainty. That said, clinical practice involves much more than science. The thought of revealing stories of disability and illness can often shield the patient from ever reaching out to the physician in the first place. Emotions such as shame and nervousness have the potential to prevent the patient from making even the tiniest first steps in bridging the divide between the unknown and the curable. Understanding emotion and providing empathy build the framework for that bridge's foundations.

According to data from the National Violent Death Reporting system analyzed by Gold, Sen, & Schwenk (2013), "having a known mental health disorder or a job problem which contributed to the suicide significantly predicted being a physician." Data from this same study also found that physicians were much more likely to have drugs such as benzodiazepines, antipsychotics, and barbiturates present during post-mortem toxicology testing. It is clear from multiple studies and stories that both medical students and physicians are suffering from an epidemic of mental illness. What is worse is that "[despite] their seeming greater access to primary and specialized mental health care, physicians in our study had no higher rate of antidepressants detected from toxicology testing, suggesting they were no more likely to be receiving pharmacologic treatment for depression" when compared to controls. There is a clear stigma surrounding reporting and receiving treatment for mental illness even among the medical community. Perhaps the origins of this stigma lie in the fact that doctors themselves are taught to never let emotions interfere with their clinical practice and to always greet patients with a "fresh face" every time. Medical students too often have to put their own mental health aside and spent increasingly great amounts of time preparing for tumultuous pressures like exams. Sacrificing their mental health in the name of academic advancement, however, prevents the budding student from ever fully developing emotionally, leading to a false sense of emotional security. When continued emotional repression is combined with the stigma surrounding seeking

treatment for mental illness, it is no wonder that the jaded physician often seeks their own treatment in the form of self-administered pharmacological treatment (Current Psychiatry, 2011).

The humanities can strengthen one's emotional understanding and awareness to an effect that is far beyond therapeutic. Artists, authors, poets, as well as

"Connecting to patients via absorbing their narrative over long periods of close contact can give the physician a perspective on that person's biology that scrawls on a chart sometimes cannot provide."

those in the social sciences such as anthropologists, psychologists, and sociologists alike have written and documented extensively about various portrayals of mental illness and sadness across multiple cultures. When analyzed carefully, human depictions of emotion allow the observer to connect to the creator even across time's long strands; if the future physician chooses to intensively analyze past creations such as those by Poe, Dickens, and Van Gogh, they gain the valuable insights that link perception, emotion, and creation. These analyses shouldn't be done alone either; teamwork among medical students when analyzing works of art can generate social and emotional bonds via collaborative, reciprocal learning that otherwise would have not occurred. Through this experience, medical students not only learn how people in the past communicated their own stories, but also further develop the empathetic skills and knowledge required to emotionally connect with their future patients and colleagues. This resonance is a key component of working to ameliorate the stigma surrounding physician mental illness; if students receive more training to recognize and empathize with sadness, they are able to aid their colleagues collectively as they survive rigorous medical curricula together.

In essence, studying the humanities allows us to unlock the tools of empathy that years of education in the rational and impersonal sciences have worked to almost eliminate. We are taught in our culture that emotions are entities to be controlled, and that ideal physicians can show skill and bravado by controlling their emotions while dealing with the tide of vulnerability that steps into their clinic. This perception of emotion essentially works to separate the budding medical student's emotions from their environment; additionally, the almost constant aim of students to maintain control, rather than express and study, their emotions often leads to disastrous consequences such as mental illness and suicide. Physicians and medical students should therefore work to establish and develop reciprocal and emotional relationships with their patients and colleagues, with the physician working to share their

deepest selves with patients when applicable. This bridge's foundations can only be laid if the physician studies and appreciates the powerful role of narrative in building the physician-patient relationship.

Perhaps the greatest clinical treasure the budding physician extracts from studying the humanities a student can explore the tools and gifts that the humanities offer at any point in his or her academic development; from finger painting as a toddler to a (revisited) reading of *The Yellow Wallpaper* in a college English class, students have multiple opportunities to rigorously study the humanities; for students in the hard sciences, these opportunities are often few and far between. The accessibility and power of the humanities is what makes it so special, and additionally these advantages are what emphasize the critical need to keep and increase humanities education for all careers.

As future medical students, we need to obtain a basic medical foundation through rigorous study of all the basic sciences. Bridging this study of science to optimized clinical practice requires significant training in empathy. Literature in the humanities constantly reminds us of what it means to be human, helping the young physician to connect to each and every patient's story of illness. Such an understanding is only in its nascent stages in modern medicine. It is my hope that as I progress through the medical field, I too will build and reinforce my sense of empathy such that I can connect with my patients. For me, I still continue to learn each and everyday valuable lessons in empathy by studying the humanities in my courses. It is my hope that such treasures will go on to be the source of both my and my patient's wellbeing when I practice in healthcare.

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A Paralyzing Resurgence: The Recent Polio Outbreak in Nigeria

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Edited by: Ayushi Sharma

Reviewed by: Dr. Melvin Konner

Polio was once a word that made Americans fear for their children's lives. It was not too long ago that this infectious disease plagued the world and caused severe sickness, and in some cases, paralyzed and killed people. Global health efforts have since made remarkable strides: in 1988 there were 350,000 people worldwide infected with polio, and in 2015 just 74 cases were reported (WHO, 2016). Nigeria, a country that accounted for more than half of the world's polio cases in 2012, has now put the disease back in the news in the worst possible way (WHO, 2016). Around August 11, 2016 it was reported that two, or possibly three, cases of wild poliovirus had been identified in a northern part of Nigeria called Borno State, paralyzing children. This devastating development came just months shy of Nigeria claiming official polio-free status. Now, vaccination efforts have quickly been mobilized and scientists are scrambling to find out as much as they can about the new cases. While several possible factors may have contributed to the recent outbreak, there is one that seems most daunting: the foreign occupation of Borno by the terrorist group Boko Haram.



These Nigerian children have been disfigured by Polio. The virus targets the body's muscles, making them weak and difficult to use. Infected people may need assistance from crutches or family just to walk.

Poliomyelitis is a virus that infiltrates the body through the fecal-oral route and multiplies in the intestines (WHO, 2016). Children five years and under are more frequently infected with the virus. Typical symptoms of the illness include flu-like symptoms, nausea, vomiting, fever, stiff neck, and headache. Symptoms like these are exacerbated when the infected person is already malnourished and living in a poor country, as are the children of Borno. The next phase of the illness is paralyzing. While the virus does not always affect the nervous system, the results

are devastating when it does. The virus preferentially destroys nerve cells in the spinal cord that control muscles. The result is wasting away of muscles, difficulty moving, and possible paralysis. In extreme cases, the virus can even compromise the infected person's ability to breathe when the attack occurs at the brainstem, leading to death (WHO, 2016).

While there is no cure for polio, there is a vaccine. One form of the vaccine is administered orally, only takes two drops to vaccinate a child, and does not necessitate the use of needles, medical equipment, or medical professionals (WHO, 2016). This method of vaccination is ideal for developing regions like Borno. Polio is particularly difficult to diagnose because the characteristic symptoms of paralysis are sometimes delayed or absent. The cases in which polio occur without paralysis are extremely dangerous. The virus is still transmittable to other individuals, and has the potential to spread throughout a large population relatively unnoticed. In fact, this may be exactly what happened in Nigeria. Before the recent outbreak, the last known case of polio in the country was one isolated incident in 2014, and another in 2011. It is hypothesized that the recent cases in August 2016 are linked to the same strain as the 2011 case, meaning that the virus has in fact been circulating throughout the Borno region of Nigeria for years (Roberts, 2016).

There are several theories as to why the present outbreak may have occurred. One idea is that in the years after massive vaccination efforts were employed throughout the country, the organizations responsible for vaccinating let down their guard. In other words, "commitment waned and complacency set in" (Tomori,



The oral polio vaccine only takes two drops to vaccinate a child from the virus and can be quickly and effectively administered to many children.

2016). Indeed, there are far more cases of endemic polio in Afghanistan and Pakistan, so international organizations may have decided it was best to focus their efforts elsewhere than Nigeria. This might explain why the virus was circulating throughout the region undetected for years, leading to the two or three new polio cases this past August.

There is another factor that may have contributed to the new outbreaks, and will almost certainly pose problems for future vaccination efforts in Borno. The northeast region of Nigeria is currently occupied by a terrorist group named Boko Haram. If the name sounds familiar, it is because this is the same group that kidnapped 276 girls from the Chibok area of Borno in 2014. Most of these girls have still not been rescued, and as recently as September 16, 2016, the Nigerian government has failed to negotiate the return of the girls (Searcey & Stein, 2016). The presence of this group in Borno introduces a complicated roadblock in future efforts for vaccinating and treating the children who are at risk for developing symptoms of polio, or caring for those already affected. Oyewale Tomori, the President of the Nigerian Academy of Science, explains that Boko Haram's presence has contributed to an "environment of insecurity" for the people in the areas affected by polio (Tomori, 2016).

The name Boko Haram translates to "Western education is forbidden." Experts hypothesize that Boko Haram aims to overthrow the Nigerian government and replace it with its own form of government (National Counterterrorism Center, 2016). The organization has been known to commit violent acts against the Nigerian government as well as against civilians. Because of this foundational bias against Western institutions, Boko Haram is highly unlikely to allow health organizations like WHO to vaccinate and treat children living in Borno. Perhaps unsurprisingly, the terrorist group has been resistant

"Oyewale Tomori, the President of the Nigerian Academy of Science, explains that Boko Haram's presence has contributed to an 'environment of insecurity' for the people in the areas affected by polio."

to efforts sponsored by the Nigerian government to stop the spread of polio. Boko Haram's opposition to healthcare initiatives is not only passively contributing to the problem of polio in Nigeria, but also actively destroying previously established vaccination and treatment efforts. International groups or government workers were at risk of being killed if they entered areas occupied by the terrorist group, and Boko Haram was also burning and destroying villages and neighborhood clinics (Beaubien, 2016). The recent cases of polio in August 2016 were only discovered after intensive Nigerian army efforts against Boko Haram allowed some children to escape, but there is no way to know

how many of the children under the terrorist group's occupation may still be infected. When children can escape, vaccination groups that border areas of terrorist occupation are waiting to vaccinate them right away. This specialized effort, called roadside vaccination, is currently the only preventative measure possible in Borno (Beaubien, 2016).

Back in the Western World, polio experts are concerned about the newly discovered cases in Nigeria. Emory University School of Medicine professor Dr. Walt Orenstein has studied polio eradication efforts and says that polio cases leading to paralysis are "just the tip of the iceberg" (Beaubien, 2016). These cases of polio are the ones most likely to be noticed by health officials because of the obvious impairments, such as paralysis; however, many more cases of polio are unlikely to be detected because the symptoms are not as apparent. Although the presentation of symptoms appears less severe, infected children who do not display signs of paralysis are still highly infectious and



The Boko Haram group predominantly occupies the North-eastern region of Nigeria, called Borno State. This is also the sight of the recent polio outbreaks.

can perpetuate the spread of the disease. The World Health Organization is concerned that the virus has the potential to spill over into the neighboring countries of Cameroon, Chad, and Nigeria (Beaubien, 2016). An outbreak of this magnitude would signify a devastating setback for previously established polio eradication efforts. Though the spread of the virus to the western world is not currently a major threat, it is always possible that an infectious person could travel to a polio free country and create a global health threat.

It is worth noting that there are individuals who believe worldwide polio eradication is unrealistic, even without considering the effects of the terrorist organization Boko Haram. Experts have long been aware of several factors making it near impossible for polio to be completely eradicated: high proportion of subclinical cases, vaccine derived polio, political changes, and extended duration of polio eradication programs (Arita, Nakane, & Fenner, 2006). As previously discussed, not all polio cases present with paralysis, yet those with non-paralytic polio can still transmit the virus to other individuals. In fact, it is

estimated that for every one case of paralytic polio, there are about 100-200 cases without paralysis (Arita et al., 2006). These cases almost certainly will go unnoticed. There are also rare instances in which the oral live polio vaccine can induce polio in the user, a devastating setback for the treatment that is the first line of defense in developing countries. In addition, countries with the highest rates of active infections are the most impoverished countries. For polio eradication to be effective, individual countries must each devote much of their money and resources. An effort like this is not impossible, but is quite unrealistic, for poor countries. Finally, experts recognize that disease eradication programs shouldn't exist for too long, or else motivation and enthusiasm will certainly diminish over time. This point has already been recognized as a possible cause for leniency in Nigerian polio vaccination efforts. Optimal program existence time may be around 10 years, as was the program length for smallpox, but the polio eradication program has been around for about 28 years. These factors lead experts to believe that worldwide polio eradication may not be possible. And now considering the additional concern of the Boko Haram group future eradication efforts do seem difficult to accomplish.

The influence of Boko Haram in Nigeria illustrates the direct and adverse effects of terrorism on an entire population's health and well-being. The polio virus not only poses a risk to individuals living in a terrorist-occupied area, but also to populations of people living in neighboring regions and countries. The terrorist occupation currently makes it nearly impossible for all individuals to be vaccinated, or even just to get an accurate estimate of how many Borno citizens are affected. Public health officials are unsure how immunization efforts could be deployed to the presently occupied area beyond the roadside immunizations being used now. This is an obvious and seemingly insurmountable barrier to immunization efforts that not only warrants attention from the anti-polio community, but also necessitates stronger facilitation from the Nigerian government and international peace-keeping organizations.

Although these new cases of polio have garnered international attention, the long-standing poverty and terrorist occupation of the Borno region of Nigeria is anything but a recent phenomenon. As more information is gathered on the situation in Borno, it may become apparent how best to move forward with vaccination efforts—whether or not this includes negotiations with Boko Haram. Either way, the best interests of the Borno people must be kept in mind. The Borno children are being infected and treated inhumanely. Their inherent right to peace and health must be the motivating factor for world and health officials to decide the best way to end the complicated polio outbreak in Nigeria. It is also important to remember that the threat of Boko Haram is not the only factor halting polio eradication. The terrorist organization may be an additional factor that world

leaders must now seriously consider, but longstanding problems for polio eradication are still present, as they have been for decades. Just some of these problems include presence of subclinical cases, ever-growing world population, severe poverty in areas most affected by polio, and diminished motivation for the polio eradication program that has been in existence for over 25 years (Arita et al., 2006)

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Biomedical 3D printing: Ethics and Innovations

Authored by: Divyaansh Raj and Daniel Bujnowski
 Edited by: Lucy Galvin

Reviewed by: Dr. Michael Crutcher, PhD

The recent three dimensional printing revolution has changed the standard approach to medicine through its myriad of applications. The continuous expansion of this field of biomedical technology coupled with the decreasing prices of 3D printers allows physicians to readily use these new techniques without the financial burdens associated with new technological discoveries. According to the New York Times, 3D printers that cost \$20,000 two years ago can now be purchased for \$1,000 (Bilton, 2013). In addition, many websites facilitate the sharing of individual 3D templates, allowing anyone to print a medical device through a private printing company. Currently, physicians use 3D printers to create custom organ models, regenerative tissue implants, and prosthetics and braces.

One of the earliest applications of 3D printing was the creation of custom 3D modeling to practice invasive surgeries. The printers manipulate a relatively cheap hydrogel substance that mimics real tissue (Hermsen et al. 2016). According to a recent survey reported in The Journal of Thoracic and Cardiovascular Surgery, two surgeons preparing to treat two patients with left ventricular outflow tract obstructions with hypertrophic cardiomyopathy tested the 3D printed models before the operation. To create the models, physicians first took computerized tomography scans (CT scans) of the patients' hearts to obtain detailed images which were then transferred to sterolithographic files used by 3D printers (Hermsen et al. 2016). After the surgery, the doctors rated the models from 1-5 through a set of categories including the "tissue feel, scale" and the "positioning" of the left ventricular valve in the model. Both ratings (3.5 and 3.6 out of 5)--1 for a waste of electricity to 5 for it being identical to the operating room--reflect the medical accuracy of the model. Although it is not essential for common surgeries, this new 3D printing technique can correctly depict "patient-specific" organs for surgeons to practice for unusual operations (Noecker et al. 2006).

Apart from passively helping a physician practice a surgery, 3D printing is used to actively regenerate desperately needed organs. In 2015, 122,071 people remained on the waiting list for an organ transplant (U.S. Department of Health and Human Services). The high cost and incredible demand of transplant organs place many patients who require this procedure at a disadvantage. The recent advent of 3D printing looks to reduce these barriers by printing customizable implants and scaffolds that permit faster tissue regeneration. Despite this technique's

limitations on growing complex organs such as the heart, it has been used to regrow bones. In order to create a scaffold, physicians mix biomaterials as well as 3D powder printed "ceramic, and polymer powders with suitable binder fluids" (Rücker, Kirch, Pullig, and Walles 2016). Cells are arranged in hydrogel or inkjet with the powder printed materials and are released in layers, the number of layers being the 3rd dimension: height. The structure of the scaffold promotes cell "infiltration and proliferation" and uses biochemicals "to direct cell behavior" (Chia, 2015). The scaffolds are then injected into the desired area of cell regeneration. This technology is especially helpful for patients suffering from "a critical size bone defect"--a deformity that will not heal in the person's lifetime, such as one caused by diabetes or radiotherapy (Rücker et al. 2016). The advantage of 3D printing scaffolds as opposed to the traditional method is the added "control of speed, resolution, cell concentration, drop volume, and diameter of printed cells" (Ventola, 2014). This ultimately allows greater variability and customizability of scaffolds based off of an individual's specific needs.



Examples of 3D printed scaffolds

3D printing has extensive implications for the creation of otherwise expensive prosthetics. According to the National Institute of Standards and Technology, a bottom line prosthetic leg costs anywhere from \$12,000 to \$15,000 (Ventola, 2014). Biomedical 3D printing aims to reduce this price to hundreds instead of thousands of dollars which has been somewhat accomplished through the sharing of individual designs online. People in need of prosthetics or therapeutic braces can seek the advice of physicians and 3D print the advised design instead of paying thousands for the same molded prosthetic/

brace. The process of printing prosthetics is essentially the same as that of scaffolds, differing solely in the materials used for production. Throughout the past decade, these possible materials have extensively increased and can currently vary from inexpensive plaster to costly silicon.

With investment in bioprinting projected to increase by 7 billion dollars in the next decade, it is fair to say that major innovations in the field will occur at an exponential rate. It is, therefore, important to assess the societal impact bioprinting has and ethical dilemmas bioprinting presents. The integration of any engineered product with the human body often triggers various ethical qualms. Concerns regarding the “violation of human dignity”, respecting religious beliefs, the source of the bioproducts, and the impact on societal structure are important to consider. With these moral constructs in mind, it is important to shape regulations that guide bioprinting in a way that helps it coexist with current societal beliefs and structures. In this article we plan to examine the possible social, political and economic implications of bioprinting and propose solutions to regulate the development of bioprinting as the technology continues to advance (Tran 2014).

The biggest impacts from bioprinting will most likely be felt by the social and socio-economic spheres of modern society. As bioprinting becomes a more reliable and viable clinical tool, the initial prices of reliable organs will be hefty. This is because of low supply for a versatile product that is already in high demand. As a result, at the inception of these advancements clinical treatments using this method will be effective, but such benefits will only

“Concerns regarding the ‘violation of human dignity’, respecting religious beliefs, the source of the bioproducts, and the impact on societal structure are important to consider”

be for those who have enough money to afford this branch of treatment. If the timeframe of this impact is extended over a long period of time, high income patients will have a lower mortality rate from organ crippling conditions than low income patients -- who will be waiting for human organs to become available for transplant. The expense of bioprinting will therefore reinforce existing disparities in healthcare quality by limiting its availability to individuals with higher incomes, creating differences between them (Tran 2014).

Bioprinting can also be used in the future as a method to enhance and modify features of the human body. The idea of “designer bodies” can also have a dramatic effect on the social structure of our society. Many people will want to use bioprinting not just as a clinical treatment, but as an opportunity to gain a tactical advantage in sports, academics, or

society (Varkey 2014). High-income athletes could potentially transplant specialized organs into their body as a way to gain competitive benefits (Tran 2014). The top 1% of society has the opportunity to invest in treatments that will make them physiologically superior to regular people. Ultimately, as cosmetic bioprinting become more acceptable, the dichotomy between the middle/lower class and upper class will grow sharper.

Other ethical quandaries that emerge from the concept of “designer bodies” involve conflicts with religion and the infringement of human identity and dignity. The integration of lab-engineered organs is a religious concern due to the possible sourcing options for stem cells that will be used in the printing process (Konieczka n.d.). Some major sources of stem cells are aborted fetuses and umbilical cord blood. Due to an already unstable consensus on abortion, there might be significant backlash from conservative bodies when bioprinting is considered as a viable clinical option. Additional ethical concerns might regard

“It is important to consider how treatment options can have societal repercussions on patients so that those that are made physically better aren’t also made social pariahs.”

whether bioprinted organs violate a person’s dignity and identity. Many contend that the integrations of bioprinted body parts changes the identity of the patient and makes their intrinsic quality of being human, questionable. It is important to consider how treatment options can have societal repercussions on patients so that those that are made physically better aren’t also made social pariahs (Tran 2014).

The impacts bioprinting can have on the political and economic sphere are also considerable. The most significant impact to the political and economic structure of our country is the possibility of a bioprinting black market. As previously discussed, the incredible demand and short, patient-specific supply will result in high prices for bioprinted organs. As a result, many scientists with access to bioprinting technology have the opportunity to sell bioprinted organs at a lower price using the black market. While the emergence of an organ black market could be economically disastrous for companies selling bioprinted organs, the impacts stemming from this issue are greatly political. As bioprinting emerges, politicians need to work ahead to make sure that the incentives for a black market do not appear in the future (Varkey 2014). This is imperative because black market organs are void of safety protocol, background checking, liability, and proper surgeons for transplant (Tran 2014). Many leaders in the field of bioprinting consider it essential that a subcommittee of government be created specifically for cases related to bioprinting.

Political action through preemptive legislation is necessary to accommodate even legal bioprinted organ transplants. Liability clauses necessitate a need to be established in case of infection, organ-rejection, and defection of the created organ (Konieczka n.d.).

While there are substantial ethical, political, social and economic concerns regarding bioprinting, it is equally important to discuss a potential solution. One commonly supported political regulation plan is called a “relaxed federal standard” (RFS). The relaxed federal standard is a joint effort between the legislature and medical professionals. As a combination of several regulative policies, the relaxed federal standard says that “except for research and emergency, bioprinting regulation should be regulated” (Tran 2014). Granting administrative agencies access to bioprinting blocks and blueprint upstreams would be a potential source of regulation for this type of technology (Varkey 2014). The RFS also calls for a prohibition on sales. It is also argued that aforementioned administrative agencies should stem out of existing organizations. This part of the plan would save money, time, and aid in the easing in of new regulations. The organization would also help create a pipeline from possible controversies to the judicial system. The advantages of such a system are that science and technology are allowed to progress while being kept in moderate check. Many researchers argue that while this plan may be too relaxed, the possible benefits from this technology might be worth the risk and might bring along a myriad of health-related benefits.

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Cupping: pseudoscience or Olympic-winning treatment?

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Reviewed by: Dr. Kim Tran, MD, PhD

Amidst the ceremonies, gold medals, and swimmer scandals, the 2016 Summer Olympics brought a medical controversy back into the media's light: What happened to Michael Phelps' skin? The answer to his purple-spotted back lays in a 2000-year-old therapy. Cupping is an alternative medicine practice primarily known in the United States as popular with Hollywood celebrities, such as Jaden Smith in *The Karate Kid*, and athletes. A technique born in ancient China, cupping involves depressurizing cups that raise the skin from underlying muscles (Dharmananda, 2015). Practices can involve suction, fire, and even bloodletting to promote overall blood flow. For example, a small amount of blood is drained in the process of wet cupping, whereas a non-invasive approach such as dry cupping relies solely on the



Michael Phelps' Instagram post depicting the cupping procedure

depressurizing process. The pressure, however, often results in ruptured capillaries leaving cup-shaped, purple bruises on the skin. Although western medicine has largely dismissed cupping as pseudoscience, empirical studies completed in recent years imply that cupping could be responsible for helping Phelps win those 23 gold medals (Marcus, 2016).

The popularity of cupping among athletes, particularly those in the eastern hemisphere, has

stimulated biomedical research to investigate the alternative medicine's efficacy and mechanisms. One survey in particular investigated 166 injury cases among Korean national volleyball players (Yang, 2016). Cupping was one of several alternative medicine therapies implemented preventatively and post-injury among the study subjects. In the treatment for a wide variety of injuries, cupping was particularly implemented to treat muscle strain and manage pain. American athletes similarly cite pain management as the primary reason for seeking cupping therapy, and promote the idea of a multimodal combination of treatments. Another study where 80 people treated with a combination of acupuncture, cupping and acupressure found that cupping assisted in the management of neck and lower back pain (Albedah, 2015). Additionally, an analysis of 320 people who received cupping treatment compared to the "usual care" control group (physical therapy, NSAIDs, and massage therapy) reported lower pain scores, lending great clinical significance to this alternative medicine technique (Yuan, 2015). A review on acute and chronic pain management found similar results especially when comparing cupping to "western" drug treatment such as mecobalamin injection, diclofenac, and flunarizine (Cao, 2014). In these studies, pain was measured by a variety of pain scales (visual analogue scale, numeric, etc.) Additionally, the research often incorporated trials that combine multiple therapies, as well as

"...individuals with cupping treatment compared to the "usual care" control group (physical therapy, NSAIDs, and massage therapy) reported lower pain scores, lending great clinical significance to this alternative medicine technique."

cupping-only experiments. These studies represent only a small portion of the research that aims at promoting cupping for pain management and muscle strain, suggesting scientific support for the therapy's popularity amongst athletes.

While these randomized control trials provide evidence of cupping's efficacy in chronic pain management, the studies receive skepticism due to the subjective nature of their data. These critiques

are common towards a wide range of alternative medicine studies. Perhaps the subjectivity results from treating subjective symptoms such as pain or stress, which generates data based on subjective scales. Many alternative medicine practices also aim at an overall health benefit rather than treatment of a particular symptom. The Ministry of Health in Saudi Arabia sought to improve this design flaw last year by analyzing the influence of wet cupping on blood pressure (Aleyeidi, 2015). Hypertension remains one of the top mortality factors worldwide. Unfortunately, current medication for hypertension can only lower blood pressure on a day-to-day basis, which necessitates the development of long-acting, potent medications. In this study, a comparison of systolic and diastolic blood pressure among 80 participants revealed lower blood pressure in the experimental cupping group compared to the

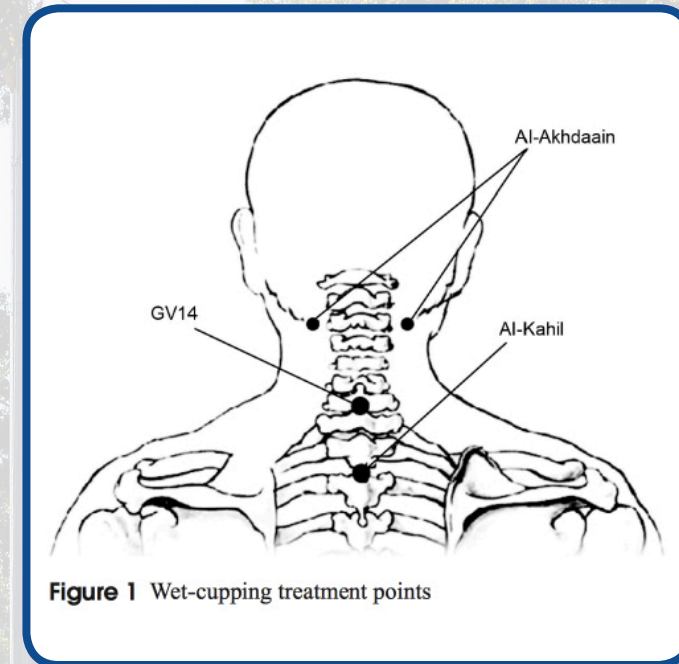


Figure 1 Wet-cupping treatment points

Diagram of treatment points in the wet-cupping technique. From Aleyeidi et. al (2015)

control group for four weeks post-treatment. This study offers the advantage of a more objective measurement in determining the efficacy of wet cupping. Even so, the long-term efficacy of the therapy remains ambiguous.

Although some studies on cupping have attempted to utilize more objective research designs, scientific communities, particularly in Western countries, have pointed out other general limitations of studies on alternative medicine. Pain scales, as formerly mentioned, are subjective to the patient and are variable in magnitude measurements. Consequently, alternative medicine research would benefit from standardizing the pain scale on an international level. Randomized clinical studies on cupping techniques are also often criticized for small sample sizes, which generates

more anecdotal proof than factual, statistically significant evidence.

The biggest concern with alternative medicine research, however, is the issue of uncontrolled



Cups can be made of ceramic, bamboo, or glass depending on the technique. Pictured here are glass cups that are most commonly used in modern practices.

experimental bias. The process of acupuncture, massage therapy, cupping, and other manual therapies creates difficulty in blinding to eliminate bias. One review cited studies that utilized a sham cup containing a hole to reverse the depressurizing process (Yuan, 2015). While this technique could be useful as a control method in future research, the majority of the research performed so far did not employ blinding procedures. American culture often mentions the high likelihood of a placebo effect in cupping. Phelps' personal trainer pointed out in an article, "There is a psychological component where Michael has been doing this to feel good for a long time..." (Reynolds, 2016). Although some athletes will defend the practice regardless of the process, the experimental designs for research on cupping must correct its current lack of blinding procedures in order to gain more acceptance in Western medicine. Objective measurements and standardized data scales, for example, could break the placebo-centered stigma and provide practitioners with biologically based evidence of the therapy's efficacy.

What could these biological explanations be? Several studies propose that, in relieving pain,

"In essence, cupping catalyzes the immune response around strained or damaged tissue by enhancing cellular communication and promoting processes that expel noxious substances."

cupping stimulates nitric oxide production and decreases oxidative stress. Cupping could also stimulate hyperemia—increased blood flow—in damaged sites as the depressurization causes blood vessels to dilate. The local inflammation and blood circulation would enhance production

and circulation of cytokines (Reynolds, 2016). The Taibah University of Saudi Arabia hypothesizes that cupping leads to draining of interstitial

“Instead of stigmatizing treatments due to historical eastern origins, the scientific community could improve its dialogue on international medical care by promoting investigation of alternative medicine practices.”

and intravascular fluids, which results in the elimination of free radicals and vasoactive substances within the blood (Aleyeidi, 2015). In essence, cupping catalyzes the immune response around strained or damaged tissue by enhancing cellular communication and promoting processes that expel noxious substances.

Unlike opinions on ibuprofen or physical therapy, Americans generally remain skeptical of the efficacy of cupping therapy for pain management. The lack of alternative medicine research in Western countries compared to Asia and the Middle East reinforces the stigma that cupping does not “belong in Western medicine.” While studies could improve experimental designs to control for placebo effects and data skew, there has been significant empirical evidence of improved pain management in alternative therapies. Multimodal approaches, including cupping, appear to be more effective in both anecdotal reports and experimental studies.

Fortunately, the stigma against alternative medicine is beginning to fade. Aside from US athletes, the US army has been integrating alternative medicine practices such as yoga, acupuncture, and cupping since 2009. Herbal treatments and supplements have also gained traction in the medical world over the last decade. Instead of stigmatizing treatments due to ancient origins, the scientific community should improve its dialogue on international medical care by promoting investigations on alternative medicine practices. Maintaining an open and objective mind is not only helpful, but necessary as we move into a more globalized world.

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Ethics and Neurotechnology in the Disorders of Consciousness

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Vegetative states, wakefulness, and the state of coma represent a subset of physiological phenomena incorporate the definition of consciousness (TI Cochrane & MS Williams 2015). Descartes once said “I think therefore I am,” an adage that encompasses a popular view on consciousness. However, the components of consciousness extend well beyond a simplified quote. Our understanding of consciousness fundamentally shapes the laws that play into cases of clinical care. In particular, the decisions made in disorders of consciousness present doctors and lawmakers with unprecedented ethical considerations. In addition, the advent of novel neurotechnology may further blur this ethical line, simultaneously presenting a means of hope and concern.

Due to the gravity of clinical decisions that impact patients’ lives, defining the philosophical perspective behind clinical decisions is imperative in understanding each case and possible resolutions. To begin, we go back to one of the well-documented understandings of the mind and body: Cartesian Dualism. This philosophy illustrates that the mental state can exist outside of the body, while the body itself does not have the ability to think independently. In this philosophy, the mental component interacts with the physical body to produce earthly actions (Hamilton S & Hamilton JT, 2015). However, the basic problem comes with the question of how the mind can interact with the body, which Descartes’ disciples claimed was produced by the pineal gland.

We now know that the pineal gland is not the link of interaction between the physical and mental entities, but rather a gland that produces melatonin and regulates reproductive hormones. However, the difficulty in explaining why any physical state is termed conscious as opposed to nonconscious continues to blur the ethical boundary between the two. In other words, the “hard problem” of neuroscience examines the linkage between “neurophysiological processes and the conscious experience” (Brogaard B & Gatzia DE, 2016).

Although the “hard problem” has no clear answer, any neuroethical case benefits from an understanding of the consequentialist and deontological ideologies. The consequentialist viewpoint involves the end outcome providing support for any ethical decision. The adage “the ends justify the means” captures the consequentialist view in a broad sense. A consequentialist view is likened to organ donation; aiding five people through sacrificial organ donation is arithmetically “better” in the end impact as opposed to death of one human (Farah M, 2015). Conversely, deontological perspective is defined as the ethics of following duty and law with respect to

individual rights. Through the view of a deontological lens, the death of the single human being in favor of the five is fundamentally flawed as the single human being’s rights and health are violated. Both perspectives possess benefits in the analysis of ethical decisions, and using either view imparts valuable information.

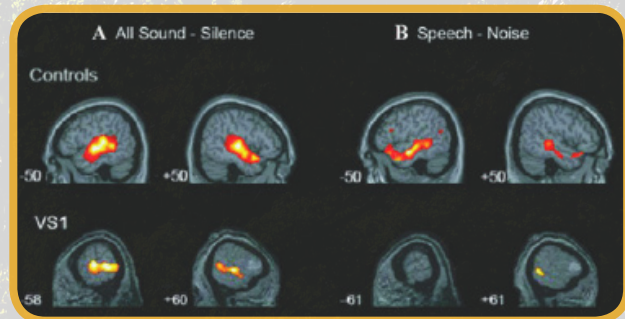
The blurred line between brain-death and life further has an important history on the idea of death itself. Until the 1800’s, death simply consisted of a lack of breathing (Goila KA & Pawar M., 2009). The definition of death then developed into the lack of circulation with the invention of the stethoscope. In the mid-1950’s, resuscitation and ventilation brought a new dimension to death. In 1968, the Harvard Criteria sought to analyze the idea of brain-death and developed six elements: deep coma, absence of reflexes, apnea, a flat EEG, exclusion of hypothermia and drugs, and repetition of the five symptoms after 24 hours (Goila KA & Pawar M., 2009). Since the Harvard Criteria, brain-death has been re-defined on multiple criteria, often due to the ethical implications that situations pose. In addition, the Universal Declaration of Death Act, written in 1981, brought a new model for state laws to follow (Verheijde, et al., 2009). The UDDA essentially consists of irreversible cessation of the respiratory and circulatory systems or the irreversible cessation of the brain, including the brain stem. These changes in policy and interpretation become evident in clinical cases. For example, the cases of both Marlise Muñoz and Jahi McCath illustrate the subtle complications that force the definition of death to adapt.

Marlise Muñoz, a Texas resident, suffered a possible embolism in November of 2013. Muñoz met the criteria for neurological death just two days after her embolism. Her closest family wished that she be taken off of life support, but 62 days continued as her body was placed on a ventilator (Bernat JL, 2014). The slight twist in Muñoz’s case was that she wasn’t the only human to be considered. Muñoz was 14 weeks pregnant, and doctors deemed life support necessary for her fetus. Although Muñoz’s family members wished she be removed from life support under her conditions, the “pregnancy exclusion” clause in Texas Law urged the continuation of life support for Muñoz’s fetus.

The story of Jahi McCath, a teenager from California, provides another ethical dilemma on brain death. McCath was pronounced brain-dead after a surgery at the age of 13. McCath’s family was notified following her declaration of brain-death, which would lead to discontinuation of life support systems (Bernat JL, 2014). McCath’s family refused to acknowledge Jahi’s declaration as “legally dead,” and pursued legal action to continue life support. This interpretation of death is

slightly different from what the UDDA outlines, further illustrating how its implementation differs from state to state. The legal case continues into this year, as her loved ones seek to find evidence that she is still alive.

These two clinical cases highlight the difficulty in differentiating criteria for brain death. However, the most intriguing future impact on ethics has come from the possibility to reverse brain-death. The most recent news on progress is from the permission from U.S. health authorities for two biotech companies, Bioquark Inc. and Revita Life Science, to attempt to reanimate human brains that were classified as clinically dead (Cha AE, 2016). The twenty patients who suffered from traumatic brain injury (TBI) would be tested to see if their central nervous systems would become responsive to treatments developed by the companies. The experiments, which are set to take place in India, may also avoid restrictions from American legal and ethical binds. To pursue the endeavor of reanimating dead brains elicits not only the philosophical conundrum of the mind and body, but also calls for an ethical perspective. Reanimating clinically dead brain tissue may go beyond the rights of the patient. As a patient, there is a very real possibility to choose to be dead, as reanimation maintains the drawback of likely losing physical and cognitive abilities. However, bringing the patient back to friends and family, or perhaps reviving people that may provide a benefit to society as a whole could be beneficial.



fMRI data from Owen et al. depicting differences between controls and vegetative state patients (VS)

Another newly developing technology on the forefront of use for analyzing disorders of consciousness is neuroimaging. One major imaging technique, fMRI, is currently used to diagnose coma. By measuring the blood flow and metabolic activity in certain parts of the brain, practitioners can determine whether a brain is in the state of coma. However, new research on neuroimaging may further blur the line on brain-death (Swarts A., 2015). Dr. Adrian Owen, a neuroscientist at the University of Western Ontario, has claimed to find evidence of consciousness in a patient who was declared to be in a vegetative state (Owen AM, et al., 2009). Owen asked the patient, Patient 23, questions and measured changes in blood flow using fMRI (Cyranoski D., 2012). To his amazement, Patient 23's blood flow changed with each question and provided him with the idea that consciousness may still be present in the vegetative state. Owen's finding highlights yet another clinical finding

that seemingly complicates the idea of brain-death and consciousness.

Owen's observation and the current research to attempt to reanimate human brains represent a relatively small portion of the advancements in neurotechnology related to consciousness. Brain death has a long history of understanding and certainly misunderstanding; however, the current strides that science takes to clarify the boundary between consciousness and death present a groundbreaking opportunity to improve the lives of patients. For example, the future may entail the ability to use advance directives—legal documents that outline end-of-life decisions—for patients who show detectable responses with fMRI. With possibilities such as advanced directives for vegetative patients, understanding brain-death and consciousness is at-once a daunting and inspiring task. As science begins the progression into new technologies for brain death, we must first consider the use, or even necessity, for advancements that could alter the human experience and the conscious experience as we know it.

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Genetic Linkages in ASD and Schizophrenia

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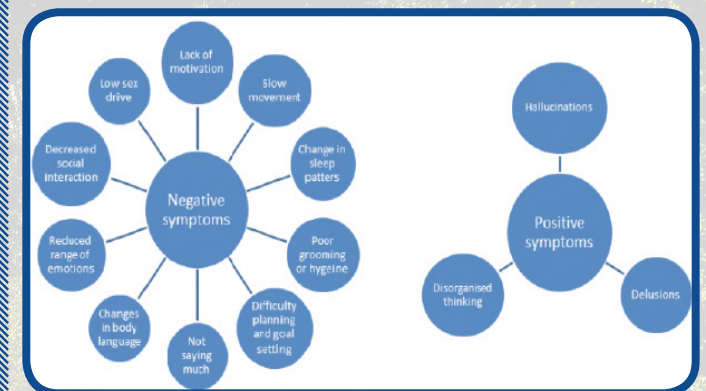
Reviewed by: Dr. Waqar Azeem, MD

Over the past several decades, the roles of neurodevelopmental disorders in the field of scientific research have been seemingly underestimated for the general public. Neurodevelopmental disorders represent a combination of various symptomatic conditions with incipience during the developmental period of individuals. These are frequently embodied and exhibited in childhood during early developmental stages, and they have the possibility to intermittently co-occur (American Psychiatric Association). Contemporary research on numerous facets of mental health has accelerated tremendously within the past decade, attempting to provide rationales for endless health queries.

In particular, current research on autism spectrum disorder (ASD) and schizophrenia has proposed the potential of both being genetically linked (Deweerd, 2016). Some researchers and medical professionals during the twentieth century firmly believed that autism was a form of childhood schizophrenia (Gewin, 2008). Autism Spectrum Disorder, commonly referred to as ASD, is a neurodevelopmental disorder primarily characterized by major impairments in social, and communicative skills. Individuals with this disorder demonstrate a restricted range of repetitive behaviors, activities, and interests (Autism Science Foundation). Schizophrenia, on the other hand, is known to be a chronic mental disorder that typically affects an individual's cognition, emotion, and behaviors (U.S. Department of Health and Human Services, 2016). Through symptomatic parallels, the possibility of diagnostic ambiguities is a plausible occurrence since there are major similarities between the key characteristics of ASD and schizophrenia. One of the major differences is that ASD starts early, usually in first few years of life, while schizophrenia usually starts in adolescent years. Modern-day researchers have scrutinized the potential genetic linkage between ASD and schizophrenia by studying biochemical brain similarities, language deficits, and self-other boundaries.

The discovery of analogous brain chemistry in individuals with ASD and individuals with schizophrenia incited interest in a potential relationship between the disorders. A study completed in 2016 reported similar patterns of vitamin B12 levels in individuals with ASD or schizophrenia. Researchers speculate that abnormally low levels of vitamin B12 in the brains of people affected by

autism or schizophrenia is a result of oxidative stress, which is a detrimental inflammatory condition (Autism Speaks, 2016). Richard Deth, study leader of Nova Southeastern University in Fort Lauderdale, Florida, claims "the large deficits of brain B12 from individuals with autism and schizophrenia could help explain why patients suffering from these disorders experience neurological and neuropsychiatric symptoms" (Autism Speaks, 2016). The similar deficiencies in B12 levels measured in ASD and schizophrenic patients are considered to be a significant finding. Since B12 levels are typically measured in the blood, it is unique that these deficiencies were only found to be present in the brains of these patients. Vitamin B12 deficiencies are also presumed to affect cognition, which correlates with the social and cognitive impairments many individuals with ASD or schizophrenia experience. An active form of B12, methylcobalamin, supports healthy brain development through a process known as epigenetic regulation of gene expression, but lower levels adversely affect early brain development and disrupt learning and memory later in life (Autism Speaks, 2016).



Symptomatic similarities between individuals diagnosed with autism and schizophrenia include numerous neurological and neuropsychiatric parallels, such as hallucinations, hindered social interactions, and cognitive impairments.

The unfavorable consequences of vitamin B12 deficiencies in the brain include cognitive impairments that manifest as characteristic deficits in language. ASD is considered to be a pervasive neurodevelopmental disorder involving deficits in linguistic cognition (Benitez-Burraco & Murphy, 2016). Research by Benitez-Burraco and Murphy (2016) supports the theory that the brain of

autistic individuals process language through the perspective of brain rhythms. Heritable components of brain function, brain rhythms are primitive yet species-specific oscillatory neural patterns that correlate with behavioral responses (Benitez-Burraco & Murphy, 2016). This deviates from normal language processing in that recent research suggests that the brain of individuals with autism requires a neuronal workspace that transcends the boundaries of core knowledge systems and cross-modular concepts.

Communication deficits are typically found in individuals with ASD. Therefore, they are more vulnerable to undergo a linguistic regression between the age of 12 and 24 months (Benitez-Burraco & Murphy, 2016). Perhaps unsurprisingly, researchers hypothesize that individuals with ASD struggle with emotional expression because of this central language deficit, which further reinforces social isolation. Children with ASD are likely to pass a phase that allows their syntactic complexity to grow; however, when interpreting syntactic constructions, they have difficulty in interpreting semantic meaning (Benitez-Burraco & Murphy, 2016). Syntactic construction refers to the grammatical aspect of syntax that has no specified boundary among its components. Due to the interference of mistranslation and the hindrance of semanticization, children with ASD are likely to have lower levels of memory consolidation.

Similarly, schizophrenia is categorized as a pervasive neurodevelopmental disorder that entails severe social and cognitive deficits resulting from their inability to properly interpret and convey



Individuals, especially children, with ASD and schizophrenia showcase impaired social cognition that further isolates them by creating a barrier that prevents emotional recognition.

language. Individuals with schizophrenia, who are typically 16 years of age or older, demonstrate language problems in phonology, which is the study of speech sounds, as well as pragmatics. This coalesces into conflicts for speech perception and production (Murphy & Benitez-Burraco, 2016). Consequently,

schizophrenics are characterized by having auditory and visual hallucinations, formal thought disorders, and delusions, which are key traits of schizophrenia in the domain of language. As previously noted in the effects of ASD, language deficits caused by the effects of schizophrenia hinder social interactions and lead to seclusion. Impairment in social cognition of individuals with ASD and schizophrenia essentially creates a dysfunction in emotional recognition of the self and of others (Tobe et al., 2016).

Social isolation creates a barrier for people with ASD or schizophrenia, emphasizing the distinction between “self” and “the other.” Both disorders are characterized by the manner in which an individual’s identity or sense of self is impacted (Noel et al., 2016). Interactions with people who do not have autism or schizophrenia, who are commonly known as “the other,” require individuals with ASD or

“Social isolation creates a barrier for people with ASD or schizophrenia, emphasizing the distinction between ‘self’ and ‘other.’”

schizophrenia to cross an implicit boundary. This implied boundary of “self” and “the other” refers to the loss of a coherent sense of self, the loss of an anomalous self-experience, and a distortion of the distinctions of one’s spatial self. Neurocognitive mechanisms that trigger this altered sense of spatial self are partially attributed to changes in sensory and multisensory function (Noel et al., 2016). According to Noel et al. (2016), individuals with schizophrenia possess a weaker yet highly dynamic self-other boundary, whereas patients with ASD possess a more rigid self-other boundary. However, those who are potentially diagnosed with both disorders—even though comorbidity is still debatable—are observed to frequently and unconsciously convert between their spatial-self and “other” boundaries depending on their environmental and social context (Noel et al., 2016).

Although researchers have acknowledged the aforementioned similarities in the presentation of the two diseases, a potential genetic linkage might make ASD and schizophrenia even more related than previously considered. The possibility of a genetic link between ASD and schizophrenia has recently emerged from research on the neurodevelopmental and neurochemical similarities of both disorders. Gene expression studies on the brains of people with autism reveal striking similarities to the expression patterns of individuals with schizophrenia

(Deweerd, 2016). Researchers found 106 genes expressed at lower levels in brains of individuals with autism and schizophrenia when compared to normal controls, and these genes are typically involved in the development of neurons—specifically the formation of synapses between cells (Deweerd, 2016). When fewer genes are expressed or are mutated, the brain has difficulty making connections necessary for normal daily cognitive function (Smith, 2014). Risk genes, known to increase the likelihood of developing a disease, bolster a link between ASD and schizophrenia. Risk genes for both disorders conspicuously activate in the same neuronal region of the brain’s cortex during infancy (U.S. Department of Health and Human Services, 2016).

However, there are a few characteristics that make each disorder distinct. Prenatal processes, such as neurogenesis, may affect genetic risk for autism, but schizophrenia risk genes impact processes during infancy, such as the refinement of neuronal circuitry (U.S. Department of Health and Human Services, 2016). The specific diverging components of brain development in an individual who could potentially be affected by ASD and schizophrenia directly corresponds with the earlier onset of autistic symptoms, which is noticed during childhood, and is consistent with the delayed onset of schizophrenic symptoms, which is witnessed in late adolescence and early adulthood (U.S. Department of Health and Human Services, 2016). Despite the overwhelming similarities between the disorders, genetic influences and environmental factors could be the cause of slight neuronal differences and social impairments (Gewin, 2008). The similarities in gene expression between schizophrenia and ASD could potentially stem from a shared mechanism of early neuronal development for the two conditions, or they may be simply reflecting common processes that solely compensate for the neurochemical alterations affecting the brain of the “other” disorder.

Images:

Physiopedia [Digital Image]. Retrieved October 20, 2016 from http://www.physio-pedia.com/File:Postivie_and_negative_symptoms.png

Wellington Retreat [Digital Image]. Retrieved October 20, 2016 from <http://wellingtonretreat.com/blog/2013/11/childhood-schizophrenia/>

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The History of Cancer Therapy and Innovations in Immunotherapy

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Reviewed by: Dr. James Lee

Cancer treatment strategies are both complex and diverse. They include surgical interventions, chemotherapy, radiation based treatments, and immunotherapy. While each of these therapeutic approaches have benefits in the fight against cancer, all have limitations that have led scientists to continue the search for other effective treatments with fewer negative effects. Immunotherapy is unique among the available strategies because it utilizes the mechanism of the immune system to fight disease. Types of immunotherapies include T-cell therapy, peptide vaccines, DNA vaccines, and monoclonal antibody therapy (Kruger, Greten, & Korangy, 2007). Monoclonal antibody therapy, in particular, is an informative example of how our evolving knowledge of the immune system has changed our understanding of tumor biology and effective ways to treat cancer. To better understand why monoclonal antibody therapy is very effective and the promising impacts that further developments of immunotherapies can have, we must first delve into the history of how cancer has been treated.

Our understanding of the human body and the development of medical techniques to treat cancer have changed significantly since the start of recorded human history. In a text dating back to 3000 BCE, an Egyptian scholar writes, "There is no treatment" in reference to a disease that is most likely cancer (The History, 2014). Doctors found that while they were able to remove tumors using surgery, the cancers would often recur in patients. 3000 years later, physicians were still facing this problem. Celsus, a Roman philosopher, wrote about cancer, "After excision, even when a scar has formed, none the less the disease has returned" (The History, 2014). Today, we understand that cancer cells behave this way because of their abnormal ability to grow and divide rapidly. Back then, cancer was a mysterious and seemingly unstoppable force due to the lack of knowledge about the disease and the tools to fight it. Today, we understand the onset and growth of cancer better, recognizing that tumor cells remaining after surgery grow and divide rapidly in an uncontrolled fashion to re-establish the cancers in patients.

Shortly after X-rays were discovered in 1895, the medical community saw the medical potential of radiation as a cancer therapy (Assmus, 1995). Physicians can use X-rays images to visualize internal structures/organs/tissues and aberrant lesions, such as a tumor, that cannot be seen by the human eye. Additionally, radiation in all its forms (high energy

α -, β - particles, as well as ionizing electromagnetic radiation such as x- and gamma-rays) can kill cancer cells by damaging the cell's DNA. This presented a means by which to kill cancer cells without having to perform surgery on the individual. However, this new approach was not without its own shortcomings: radiation also damages DNA of surrounding non-cancerous cells (Assmus, 1995). During WWII, it became apparent that the nitrogen mustard compound in mustard gas toxically affected bone marrow cells ("Evolution of Cancer," 2014). Soon, scientists discovered similar chemical agents, called alkylating agents, that can also kill cancer cells by damaging a cell's genome. This discovery offered yet another way for doctors to kill cancer cells without surgery. However, like X-rays, these chemical agents can damage healthy cells as well as diseased ones (The History, 2014). Thus, both radiotherapy and chemotherapy have their downsides, but if used correctly and efficiently, the side-effects can be limited. This basis of knowledge provided a novel and unique strategy for physicians to treat cancer using a combination of surgery and post-operative radiation and/or chemotherapeutic options targeting remaining cancer cells in patients.

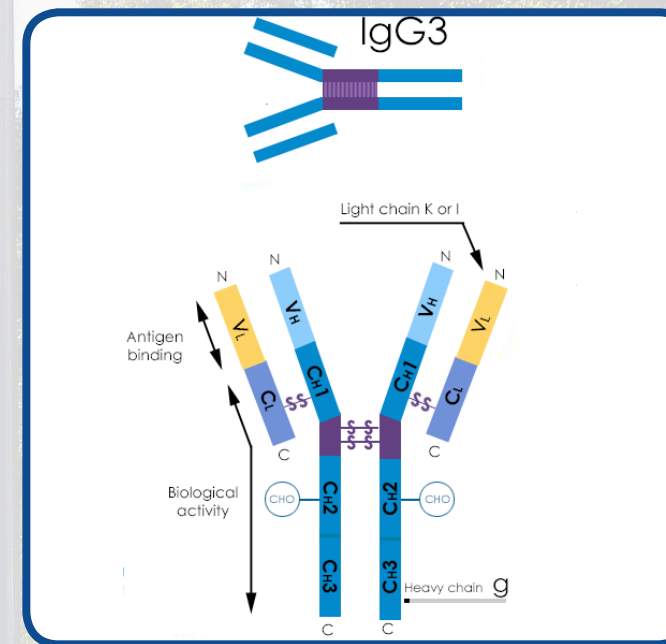
While all of these methods are still used today, the more recently developed field of immunotherapy is changing the way that doctors treat cancer. One of the most diverse and novel types of immunotherapy is called monoclonal antibody therapy (Nelson, Reynolds, Waldron, Ward, & Murray, 2000). Antibodies, also known as immunoglobulins, are proteins used in the immune system to target and neutralize pathogens. Monoclonal antibodies are made by lymphoid cells known as B-cells and are termed monoclonal because individual antibodies are derived from a single cell and its descendants.

"Monoclonal antibody therapy utilizes the specificity of monoclonal antibodies to help fight cancer by directing immune responses to the unique topography of cell surface features on cancer cells"

These antibodies function by binding to a single recognized region, otherwise known as an epitope, of a target molecule generally perceived as "non-self" to the host immune system. These target molecules that elicit immune responses are also known as

antigens. Monoclonal antibody therapy utilizes the specificity of monoclonal antibodies to help fight cancer by directing immune responses to the unique topography of cell surface features on cancer cells (Nelson et al., 2000).

Immunoglobulin G, the most common type of antibody, is composed of two light polypeptide chains and two heavy polypeptide chains that form a Y shape when bound together by disulfide bridges (Janeway, Travers, Walport, & Shlomchik, 2001). This Y shaped structure is divided into two larger components: (i) The Fc region, or the fragment crystallizable region, of an antibody, is a conserved tail region that binds to Fc receptors of different immune cells. Once an immune cell recognizes a bound antibody, it carries out an immune function such as targeting and neutralizing pathogens. (ii) The Fab region, or the fragment antigen-binding region. This is the region that gives an antibody its binding specificity that allows the antibody to bind uniquely to a given antigen. The Fab region is made up of small segments known as variable regions of amino acids that enable different antibodies to bind to different types of antigens (Janeway et al., 2001).



Structure of Immunoglobulin G, showing the light and heavy chains as well as the Fab and Fc regions.

To generate monoclonal antibodies of therapeutic value, scientists first inject healthy mice with an antigen associated with the disease of interest (Monoclonal Antibody, 1999). The antibody producing B-cells in these mice that have not previously encountered that specific antigen are known as naïve B cells. Specialized cells known as APCs present the antigen to naïve B cells, which then quickly transform into unique clones of B cells secreting antibodies that target various regions of the encountered antigen (plasma B-cells). Some of these B-cells form long lived populations

that are able to target this antigen if encountered in the future (memory B-cells). The collective pool of these individual specific monoclonal antibodies represent the polyclonal immune response the host uses as part of its humoral immune host defense. Individual monoclonal antibodies are recovered by scientists through the fusion of spleen-derived antibody secreting plasma B-cells from these mice with myeloma tumor cells. These fused hybrid cells retain the ability to proliferate in an uncontrolled fashion from the myeloma tumor fusion partner and the ability of high level secretion of the specific monoclonal antibody produced by the plasma B-cell partner. Scientists use various assay techniques to select for hybrid cells that secrete antibodies that recognize an epitope of interest. These desired hybrid cells are then grown in medium and the antibody they secrete is collected and purified (Monoclonal Antibody, 1999).

Scientists are able to use this method to make a large amount of any desired antibody. Since these antibodies come from a mouse and not a human, these antibodies might elicit an unwanted immune response when they are introduced to human patients. To bypass this issue, scientists have developed ways of creating humanized antibodies. These are antibodies whose amino acid makeup mostly matches those of human homologues, meaning that they are less likely to invoke a deleterious immune response. One way that antibodies are humanized is by CDR, or complementary-determining region, grafting. CDRs are parts of the Fab region of an antibody that bind to an antigen (Lo, 2004). Using complicated protein engineering techniques, scientists are able to isolate CDRs of mouse antibodies and attach them to human antibody frames. The success of these experiments is contingent upon very controlled environments where these delicate peptides will not fold into unwanted conformations.

Monoclonal antibodies function in many ways as a cancer therapy. As previously mentioned, monoclonal antibodies have the ability to bind to single epitopes of an antigen. This feature can be used to help prevent the spread of cancers. For example, monoclonal antibody drugs that prevent interactions between cell-receptors PD-1, also known as programmed cell death 1, and cell-surface ligands or molecules, PD-L1 (Dolan & Gupta, 2014). PD-1 is a receptor on the surface of human cells that can be recognized by T-cells, a type of white blood cell, which then elicits an immune response to ultimately destroy the cell that it recognized. This is a way that the body can destroy certain types of cells, such as cancer cells. Some cancer cells, however, have PD-L1 ligands on their surfaces that can bind to these PD-1 receptors, preventing T-cells from interacting and recognizing them. This means that these T-cells are unable to elicit an immune response against these cancer cells (Dolan & Gupta, 2014).

Scientists have developed monoclonal antibodies

that are able to prevent PD-L1 from interacting with PD-1 by blocking interactions between the two (Dolan & Gupta, 2014). This allows for T-cells to recognize the PD-1 receptors of cancer cells, eliciting an immune response against them. BMS-936558/MDX-1106/nivolumab is a type of monoclonal antibody that blocks PD-L1 from interacting with PD-1 (Dolan & Gupta, 2014). According to a study where 129 advanced non-small cell lung cancer patients were given doses of nivolumab, the median overall survival rates of patients given 3-mg/kg doses were 56%, 42%, and 27% over 1-, 2-, and 3-year periods, respectively (Gettinger et al., 2015). These encouraging survival rates highlight the effectiveness of a monoclonal cancer therapies. Immunotherapy holds a lot of promise as an extremely effective cancer therapy with monoclonal antibodies as a leading therapeutic approach. As doctors and scientists learn more about the the host immune responses to tumors, methods used to fight cancer and other diseases will show increasing promise.

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Images:

Antibody structure and isotopes [Digital image]. (n.d.). Retrieved from <http://a.static-abc.com/CmsMedia/Media/antibody-structure-and-isotopes.png>

Ethical Issues of Pediatric Facial Transplantation

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Reviewed by: Dr. Cory Labrecque

Even though the field of facial transplantation has been an increasingly developing field in medicine, the concept of facial transplantation has always been a center of ethical controversy. In the presence of many controversies, the irreplaceable benefits from facial transplantation still allowed the surgery to become widely accepted as a method of reconstructing otherwise unreconstructable adult faces (Flynn et al., 2014). However, this surgery has not been implemented in the field of pediatrics yet due to the controversy that has emerged from ethical considerations and technical difficulties. The youngest recipient noted in the literature is a 19-year-old man who received a total facial transplantation in Turkey in 2012 (Flynn et al., 2014). Prior to discussion about this procedure, our primary understanding should be based on the notion that children are not just small adults. Compared to adults, children are often the subject of greater physical and psychological fluctuation and vulnerability. These additional considerations complicate the traditional ethical controversy of facial transplantation,



Images of adult patients before and after receiving facial transplantation surgery (Pomahac et al., 2012)

making the decisions regarding pediatric procedures more complex. Therefore, applying the concept of transplantation to children requires adjustments in the procedure of selecting candidates and following up on the surgery.

Since the facial transplantation is seen as a non-life-saving or "quality-of-life" procedure rather than a "life-saving" transplantation of essential organs, the most important thing to consider before the surgery is the risk-benefit analysis. Physical differences between children and adults are one of the major factors from which the risk of medical uncertainty arises. Following is the procedure of one full-face transplantation: Facial

allograft recovery that isolates all major motor and sensory nerves and arterial and venous components from the donor is performed. Recovery of radial forearm flaps and upper limbs to act as sentinel tissues is performed simultaneously. At the same time, the recipient's skin is removed, facial tissue remnants are contoured, and bilateral motor- and sensory-nerves are preserved to allow them to return to their pretransplantation level of function in the event of transplant failure (Pomahac et al., 2011). All present facial-nerve branches and sensory nerves are anastomosed. Then, donor skin is tailored to the recipient's defects for optimal contour. Sentinel skin flaps are also transplanted to the recipient. Immunosuppression started before the surgery is maintained by mycophenolate mofetil, tacrolimus, and prednisone taper (Pomahac et al., 2012).

This particular surgery procedure was successful on adults; however, certain inherent differences between adults and children raises some problems. Some surgery techniques should be adjusted because children have relatively more face to cover, and less body available for transfer compared proportionally to adults (Flynn et al., 2014). Also, a child's growth following the transplantation can be a source for major problems. Although faster nerve growth in kids than in adults has the potential to result in excellent sensory and motor recovery, the growth of transplant can be an issue for children receiving bone and soft tissues. It is difficult to predict whether growth centers are being transplanted in the growing facial skeleton and which bone will eventually grow (Flynn et al., 2014).

Children who receive facial transplantation are also subjects of long-term immunosuppression. The most common complications that emerge from immunosuppression are infections, malignancies, and end-organ toxicity (Wiggins, 2004). Similar to the way immunosuppression plays a role in other organ transplants, immunosuppression from facial transplantation can make a patient more prone to opportunistic infections, such as bacterial, fungal, and viral infections (Wiggins, 2004). Among several sources of problem, malignancy is comparatively less fatal. Usually, patients who got transplantations of life-saving organs cannot compromise with immunosuppression. In contrast, facial transplantation patients can cause immunosuppression to strengthen the immune responsiveness against the tumor (Wiggins, 2004).

Other factors still remain threats. Among these factors is the consideration that immunosuppression will involve a lifetime of medication for the patient. A patient may resent having to take certain medications for a lifetime (Flynn et al., 2014). Uncertainty of a young

patient's ability to adhere to a demanding therapeutic regimen over the long term also poses a problem, because adolescence is a period of vulnerability and great variance (Marchac, 2016). There is a possibility that a patient who has entered adolescence decides to stop his or her medication in a spirit of rebellion, which will lead to the visible signs of rejections (Marchac, 2016).

Since identity-related and psychology-affecting characteristics of facial transplantation make this particular type of transplantation different from any other organ transplantations, problems related to the face donor is a part of the complex web of interests that require serious consideration. In the case of pediatric facial transplantation, the individuals who make donations are likely to be the parents of a child, and they may be willing to make a donation only when the donation would very likely result in a good outcome for the recipient. This contingency correlates the likelihood of parents consenting a donation with the level of assurance parents are offered (Flynn et al., 2014). The considerable uncertainty of the surgery in combination with the non-autonomous characteristic of the donation and the emotional attachment of parents to a child's face make the situation more difficult than that of adult facial transplantation.

There is also a dilemma regarding the psychological status of a recipient. While there is an assumption that children who are psychologically healthy and resilient before transplantation will recover from the transplant more easily and benefit from the transplant, the particular assumption is likely to result in the complication of patient selection (Flynn et al., 2014). Do children with those characteristics represent the appropriate subjects for facial transplantation? A dilemma in selecting patients arises along with such a question. Children who are suffering more with facial disfigurement are less likely to show ideal psychological health. And for a case in which the transplantation is inevitable for a patient with a non-ideal psychological condition, the help and emotional support of family members is essential.

Some argue that the change of face has the potential to compound the anxiety of children who already experienced fluctuation in body image, and the confusion of personal identity may result in psychological damage (Marchac, 2016). However, it is essential to understand the problems children with facial disfigurement encounter during their attempts to socialize. Beyond the physical damage, they are stigmatized, cut off from normal social interactions, shunned, and isolated (Furr et al., 2007; Siemionow, 2011). And for children, blending into social groups of peers who are less able to cope with disfigurement are more prone to cruel comments and hurtful rejection becomes a struggle (Marchac, 2016). With the perception of facial transformation as a medical reconstruction that also prevents associated psychological damages, rather than a mere transformation of appearance, the benefit of the surgery outweighs the risks.

While the facial transplantation can be a solution to severe problems that cannot be solved otherwise, complex ethical issues must be thoroughly reviewed, and a fundamental ethical guideline should be created to set the foundation of the treatment before the actual implementation. The candidates for transplantation should be selected after extensive discussion of the indications, risks, and benefits (Pomahac et al., 2012). And before the operation occurs, an important consideration for both physicians and families should be the degree of damage incurred by the injury. When the child's disfigurement is so severe that it compromises the normal ability to eat, breathe, or speak, the child is able to gain tremendous benefit from the surgery. In such a case where the result of the surgery is exceptionally life-enhancing, the risk is negligible compared to the benefit.

While the facial transplantation is undoubtedly necessary for children with severe disability, and the study (Marchac, 2016) emphasizes that there is no ethical barrier that precludes children as candidates for a full face transplantation, we cannot make a definite conclusion about the risks and benefits of the surgery at the moment. Facial transplantation in pediatrics is a new field, and the evidence based on the actual surgery is not sufficient as of now. On the other hand, if clearer conclusions regarding ethical concerns based on current and unprecedented ethical questions are made after observation of patients who received facial transplantation, this particular surgery has great potential to drastically improve many children's quality of life.

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Recreational Drug Use and Its Effects

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You've heard all the terms: Mary Jane (marijuana), Rolling (MDMA), Lines (cocaine), Tripping (LSD), a Drag (cigarettes/nicotine). With a plethora of different drugs now available, which ones are more detrimental than beneficial? New college students are more exposed to all types of recreational drugs, and their want for a "classic" college experience will prompt them to try new drugs. In the Johnson et al. (2015) study titled "Monitoring the Future," 40% of sampled college students have tried some type of illicit drug like marijuana, amphetamines, cocaine, etc., which is higher than any other age group. Our generation's use of drugs is nothing compared to drug usage during the baby boomer era, which includes individuals born in the 1950's to 1960's, but there has been an increase in the use of marijuana since the early 2000's (Johnson et al., 2015). The prevalent drug of choice among our generation of college students is either marijuana or the psychedelic lysergic acid diethylamide (LSD), followed by club drugs like MDMA (ecstasy), amphetamines and study drugs that are prescribed to people with ADD or ADHD for focus, like Ritalin, Adderall, and Vyvanse. All drugs have many short-term and long-term effects, and these effects can be either beneficial or detrimental to health.

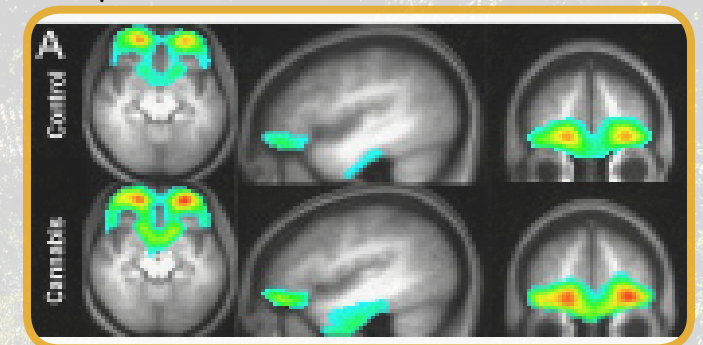
We have come a long way since marijuana was first decriminalized in Oregon in 1973. There are now four states where marijuana is completely legal, 17 states where it has been decriminalized and 26 where medical marijuana is legal. Marijuana is the staple drug of choice among college-aged people because of its ease of access and the relaxation effect that they feel. These effects are from the tetrahydrocannabinol (THC), the active component in marijuana, and THC affects the brain by inducing a rush of dopamine and increasing the activation of cannabinoid receptors, resulting in a "high" feeling. Some college students don't see smoking marijuana as a big issue; their perception of marijuana as a

"THC affects the brain by inducing a rush of dopamine and increasing the activation of cannabinoid receptors, resulting in a 'high' feeling."

"dangerous" drug has drastically decreased from 35-40% in the 1980's to 8-10% today (Johnston et al., 2015). Because marijuana is the most prevalent drug among 12th graders and college-aged students

(Johnston et al., 2015), there is the abundant research on its properties. Recent research has shown that THC and other cannabinoids (CBDs) can benefit people with a severe form of epilepsy called Dravet's Syndrome. Certain CBDs facilitate the release of neurotransmitters that reduce neuronal excitability, therefore silencing the triggers of seizures. The use of these CBDs has reduced seizure frequency by ~85% in children, with ~15% of patients seizure-free.

Among the beneficial effects of marijuana, there are some negative lifetime effects as well. Long-term use of marijuana is positively correlated with increased risk of aortic-iliac calcification, a cardiovascular disease (Rana et al., 2016). The orbitofrontal cortex (OFC) region of the brain is smaller in those who smoke marijuana frequently, although frequent marijuana users have a higher connectivity within their OFC network. The OFC is a component of the addiction network, so a higher activity in that area might be correlated to an addiction to marijuana (Filbey et al., 2014). However, this increase of connectivity and activity might be due to overcompensation for the OFC's smaller volume (Filbey et al., 2014).



Heavy use of marijuana causes the orbitofrontal cortex to shrink (bottom row), so they are developing thicker cross-brain connections as a means of compensating.

Along with long-term effects on the brain, studies have shown that persistent dependence on marijuana is associated with lower socioeconomic class compared to their parents and peers (Cerdeira et al., 2016). The economic problems that arise from constantly buying drugs and the tendency for marijuana to be addictive can perpetuate negative long-term behaviors. Additionally, some studies have illustrated that persistent cannabis abuse discourages users from pursuing higher education degrees (Cerdeira et al., 2016). Individuals who abused marijuana and consequently received lower degrees of education did not earn as much money as their

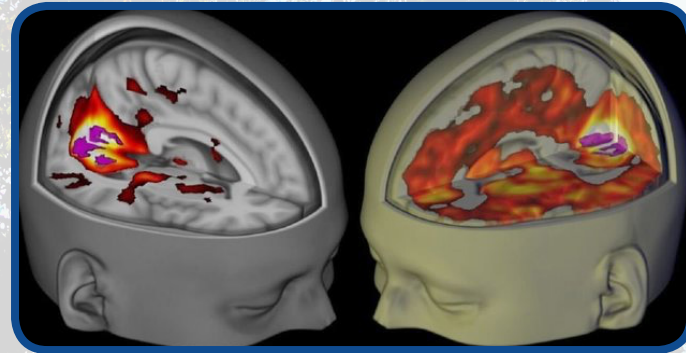
nonsmoking counterparts (Cerda et al., 2016). This trend demonstrates how marijuana use can have detrimental financial consequences. However, the negative effects that long-term marijuana use imparts on the individual's socioeconomic status is usually if addiction starts at a relatively young age, around 18, and if marijuana use continues into adulthood. The aforementioned benefits pale in comparison to the potentially harmful health and economic complications.

A second class of drugs known as psychedelics is not as common as marijuana, but these drugs produce more intense effects. The CIA has been known to use LSD for chemical warfare and in their attempts to perform mind control. This venture was quickly shut down for ethical reasons because CIA officials administered LSD to college students without their knowledge. Because of this backlash coupled with a decrease in production and an increase in awareness of the risks of using LSD, the prevalence of LSD has decreased significantly on college campuses (Johnston et al., 2015). Once the public was aware of the CIA's utilization of LSD and its damaging consequences, there was an increase in research done on LSD. Recent work has shown that, in LSD users, higher-order cognitive areas of the brain, such as the neocortex, are more heavily connected to each other (Tagliazuchhi et al., 2016). This connection leads to ego dissolution, or losing a sense of who one is. It disrupts the user's perception of reality, which is why some people view LSD trips as spiritual journeys.

Even if a person temporarily loses his or her sense of self, research is pointing towards potentially positive long-term effects of LSD use. Studies show that LSD can promote psychological well-being, such as an increase in openness and optimism in the mid- to long-term (Carhart-Harris et al., 2016). LSD stimulates the 5-HT₇ serotonin receptor; the receptor leaves a residue of serotonin that leads to an increase in optimism and social belonging (Carhart-Harris et al., 2016). There is a mid- to long-term increase in being personable and general uplifting feeling, which is an effect of the initial stimulation of these serotonin receptors which has shown from fMRI screenings an additional increase in cognitive flexibility, like creativity and imagination. Some examples of these fMRI brain images are shown below. The brain on the right is LSD-induced, while the brain on the left is a placebo. The brain image on the right shows higher visual pathway connections than the left, a result of the higher connectivity that LSD stimulates between brain networks. The heightened connectivity explains why users experience a greater sense of connectedness between the environment and ourselves.

LSD can also affect the brain by impairing our recognition of fear in faces. The Dolder et al. (2016) Facial Recognition Emotion Task showed that people who had taken 200 mg of LSD had a harder time recognizing fearful faces than those given a placebo.

In contrast, people who took LSD had no problem recognizing other basic emotions like happiness or anger. Other tests in Dolder et al. (2016) include the Multifaceted Empathy Test (MET) and Social Value Orientation (SVO) test, with the results showing



Under the influence of LSD, the brain's visual cortex has increased connectivity with other brain regions (right) than when imaged under placebo (left).

an increase in both our empathy and social skills in the respective tests. These results were compared to MDMA or ecstasy, drugs that also affect the connections in the brain by stimulating serotonin receptors. When compared to these drugs, the results showed that while LSD does help with our connections to people, the effects of LSD are not as strong as the effects of MDMA (Carhart-Harris et al., 2016).

Raves and clubs are hot spots for a third category of recreational drug called amphetamines. Cocaine, methamphetamine, and amphetamines, which are considered "study" drugs like Adderall and Ritalin, are drugs that stimulate the central nervous system and are used as cognitive enhancers. A similar drug, MDMA, has been used in research as a potential way for people diagnosed with psychiatric conditions to feel a closeness with other people. However, recent research has shown that MDMA affects serotonin receptors in a semi-permanent way and can lead to deadly diseases, such as Serotonin Syndrome. There is also a decrease in use of MDMA among college students and young adults because of the potential for relapse and detrimental effects (Johnston et al., 2015). Amphetamines don't increase the desire to learn more or different things. Instead, amphetamines just increase the activity in the individual, such as doing things quicker and without procrastination. This effect is why people with ADHD and ADD take amphetamines, and why people who want to study abuse it. There has been a sharp increase in use since 2009 because of the want to study better and more efficiently (Johnston et al. 2015). These drugs don't make the student "smarter" or help the student learn, just more focused and awake for longer (Lakhan et al., 2012). This reasoning is why the abuse of these study drugs is sought after many college-aged people

and is increasing in prevalence (Lakhan et al., 2012). That is also why these types of drugs are so addictive and the long-term effects are hard to study.

The use of all these drugs mentioned previously has obvious short-term effects. The long-term effects are also important, but they are not as well-researched. To understand the full effects of these drugs, longitudinal studies must be performed that are slow and time-consuming in nature. Studies like Monitoring the Future take decades to synthesize the data and are costly. Many students are now feigning symptoms to get access to prescription drugs, and the number of people now prescribed with ADHD medication has increased by almost 30% since 2010 (Fauber et al., 2016). There has been a lot of research from the early 2000's when drugs were making a comeback from the 1960's and 1970's, but because of the general decreasing trend, less research is being done on the actual effects of these drugs compared to the addictive factor and the psychological and physical withdrawal that these drugs can induce. The decision to take these drugs after learning about their positive and negative effects requires the individual to accept the consequences that come with it.

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Current Topics: Emory's Initiative in Global Health

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Doctors, faculty, students, and researchers all influence the way critical global health challenges are tackled. The Emory Global Health Institute, or EGHI, is a nationally renowned global health center that aims to bridge the gap between third world countries and universities. Emory's chapter of Universities Allied for Essential Medicines, or UAEM, has partnered with EGHI to explore and promote a project called CHAMPS (The Child Health and Mortality Prevention Surveillance Network). CHAMPS is a global initiative that implements a novel surveillance network in sub-Saharan Africa to monitor child mortality.



CHAMPS gathers and distributes real time data from various clinical field locations in Africa and Asia in order to determine where, why, and how children are falling ill. (Gates et al., 2016)

CHAMPS is funded by the Bill and Melinda Gates Foundation and focuses on tracking the most preventable causes of mortality of infants (Gates et al., 2016). Volunteers, researchers, doctors, professors, and students have teamed up to create and analyze 25 sites across South Asia and sub-Saharan Africa, such as Uganda, Tanzania, South Africa, Uganda, and Ethiopia, over a period of 25 years (Licht et al., 2016). Dr. Breiman is the director of the Global Health Institute and a pioneer for CHAMPS. He has partnered with many organizations and clubs on campus, including Emory Universities Allied for Essential Medicines (UAEM), in order to produce and distribute high-quality data. This information will inform policy and public health, and will ultimately grant clinical sites the ability to provide their own services and surveillance in order to prevent mortality. The implications for a project like this are

broad; CHAMPS could provide innovative methods and data to promote local, national, and global health policy. It would help to uncover the reasons that infants die in low-income and low-resource environments. One of the goals of CHAMPS is to train local and national healthcare networks to build relationships and the repertoire to create surveillance networks (Breiman et al., 2016). A surveillance network is necessary because there are many areas in third world countries where people and their respective diseases are unaccounted for. Once accurate data can be collected, then it will be easier to create benchmarks and tools to treat these diseases. Long-term, CHAMPS will develop and test interventions to battle major contributors of mortality.

One such surveillance site that has been set up and funded by CHAMPS is the Ethiopia Public Health Institute (EPHI), which was created in 2013 by consolidating multiple public health arrangements in Ethiopia (Gates et al., 2016). Specifically, the surveillance network oversees local public health emergencies, implements health-related surveys, supports the laboratory system, and implements diagnostic testing and vaccines to the public (Gates et al., 2016). This aid provides more personalized local care and more targeted research than most national organizations can offer. By creating multiples of these surveillance networks and institutes, the resulting research and local care will benefit thousands of people across many third world countries such as Vietnam, Thailand, and Africa (Gates et al., 2016).

UAEM consists of a unique advisory board from graduate students of each school: The Emory University School of Law, the Emory University School of Medicine, the Rollins School of Public Health, and the Laney Graduate School. Emory's role in CHAMPS is a unique one: the board will be informed of areas within the research that require further exploration. Once the board is apprised of new issues, the board will design research projects to target and investigate these issues. The projects that are ultimately deliverable are sent back to CHAMPS for assessment and application. In past years, UAEM has created a "report card" where the board and its associated researchers followed the production and distribution of Emtriva, an HIV drug created by Dr. Dennis Liotta. At the end of the drug's distribution, UAEM published a report on the policies surrounding the drug and how the drug was sold and distributed across the world. Some of UAEM's policy work was even referenced in the UN's annual report.

Currently, CHAMPS is working on acquiring informed consent materials for the collection of tissues samples from Africans for each of the 25 CHAMPS sites in Asia and Africa. The project aims to identify the needs and variations in each site to evaluate what informed

consent looks like. Specifically, these consent materials will ultimately lead to the collection of tissue samples in a legal and ethical manner (Breiman et al., 2016). This is where having students from multiple disciplines comes in handy: law students are currently working on policy, medical students are analyzing the efficacy of collection methods, and the public health students are analyzing the worldwide health implications of such policy.

Another project in the works ties into the consent material program; students and professionals intend to develop a system to determine the primary causes of death in third world countries. The project is focused on making the distinction between primary and secondary causes of death. Another issue is determining how many primary causes of death can one person be included in. For example, if somebody died of skin cancer, can it be classified as both cancer and skin conditions? Can an individual's death be attributed to only one cause, or multiple causes if applicable? CHAMPS will create more pinpointed data in order to accurately identify which causes of death are most prevalent, and if certain diseases are correlated with a higher incidence of other diseases. This information can be used globally to create more aggressive, targeted, and stringent methods to help disease-afflicted areas. An important aspect of collecting accurate and usable data on the causes of death involves the capacity to quantify multi-factor causes of death in easily understood infographics. In order to do this, UAEM x CHAMPS faces many important questions: How do you compare two or more different causes of death? How do you effectively represent a secondary cause of mortality?

Dr. Breiman is heavily involved in building different methods to determine causes of death. He envisions a 20-year program that will enable the translation of data to action by comparing the cost, feasibility, and statistical confidence of death determination--ranging from a complete diagnostic autopsy to a simple verbal autopsy (Breiman et al., 2016). Ultimately, he wants to provide field settings for designing and implementing interventions by creating a capillary effect of increasing will and demand for accounting for deaths that occur. Dr. Breiman's mantra is simple: "Under-five deaths are unacceptable. No child should be allowed to die." (Breiman et al., 2016)

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Student Organization Highlight: The American Mock World Health Organization

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Reviewed by: Dr. David Weiss

The American Mock World Health Organization (AMWHO) is a national organization dedicated to promoting public health and health policy debates for students around the world. The organization recently hosted its third annual national conference at Emory University this October, focused on the theme of antimicrobial resistance (AMR). During the conference, delegates came together to debate and discuss this extremely exigent topic, which timely follows the fourth-ever UN summit on a global health issue. In this sense, AMR has become an extremely important and central topic for research and public policy implementation across the globe.



Delegates attending the 2016 American Mock World Health Organization National Conference create regional resolutions focusing on the theme of antimicrobial resistance.

The World Health Organization was established on April 7th, 1948, as a global health collaboration amongst UN member states after World War II. Member states united to work together diplomatically with a common goal to direct and coordinate international health within the United Nations' system. Since its founding, the WHO has run on a system of governance that revolves around the policy priorities and fixed budget funding from member state contributions. In order to implement their agenda, the World Health Assembly meets

annually, with delegations from all member states. During this week of debate and policy creation, the WHO acts as a sponsor for mutually agreed upon international health policies. Their role can be from encouraging vertical disease campaigns headed by individual countries, expanding universal coverage and immunization, and establishing base global health protocols agreed upon by the member nations.

At the same time, the WHO itself does not have the authority to mandate member nations to follow these resolutions, which creates issues between their authoritative policies and local implementation of its policies. As such, the influence of the WHO is mostly prevalent in policy development and creation, with the implementation left up to specific member states. This relationship leads to the development of interactions with ministries of health and funding organizations such as the World Bank, dominated by different specialists from public health experts to economists.

As a result, the American Mock World Health Organization aims to create a platform for delegates to represent WHO member states and to create resolutions that will be passed to the WHO in Geneva for review in the spring. AMWHO National was founded by Neha Acharya, a then undergraduate student at UNC Chapel Hill, after she attended and was inspired by the Ontario Mock WHO. The first AMWHO National Conference was held at UNC in 2014, bringing together over eighty delegates from across the country to debate the issue of "Health in Times of Conflict." Since then, the organization has grown to encompass twelve national chapters, the first of which was founded at Emory University.

AMWHO Emory began in 2015, and was the first AMWHO chapter to host a regional conference. The Georgia Regional Conference was hosted at Emory University from March 18th to 20th, 2016 with the theme of "Improving Health Literacy through a Sustainable Workforce". Sixty delegates from local high schools and universities came together to create resolutions in a simulation of the World Health Assembly.

After the success of the regional conference, AMWHO Emory was chosen to host the 2016

National Conference, which moved for the first time from UNC Chapel Hill. This year's conference welcomed about 200 delegates, including 40 international delegates, from places such as UAE, India, France, and Egypt. During the conference,



AMWHO National Conference 2016 delegates represent WHO nations and suggest amendments to resolutions that will be sent to the World Health Organization for review.

these undergraduates and professionals took on the roles of WHO member states, media organizations, and non-governmental organizations.

Within the five WHO regional blocs, resolutions were created to address the theme of "Antimicrobial Resistance". This topic was chosen for the importance of targeting AMR before its projected massive financial and social impacts on the world within the next few decades. The United Nations recently held its fourth-ever summit on a health issue summit on September 21st, 2016, during which WHO and AMR leaders discussed the need for integrating AMR response approaches. This issue builds upon the original idea of the WHO to bring together different health experts, from veterinary medicine to agriculture, or environmental to financial directors, in order to effectively address the problems created by AMR.

In this conference, the theme of AMR was broken into five subthemes. The first was economic feasibility, in which delegates were to consider their sources of capital - both public and private - and the sustainability of funding projects and research to address AMR. Additionally, as a previous issue the WHO had faced with implementing resolutions, delegates were to address culturally sensitive education, specifically how to interact with local communities to bolster public health activities to reduce the burden of AMR. Human

resources were also considered, extending beyond the active healthcare professionals on the ground to the coordination and transport of these workforce members. The fourth subtheme addressed a major concern with AMR, specifically establishing stewardship and building surveillance, which is key to limiting the prevalence of AMR and development of new resistant microbial strains. Finally, delegates focused on promoting innovation and alternatives, encouraging research and development of new drugs or natural remedies that could prevent the rise of AMR disease types.

Essentially, the goal of AMWHO is to encourage policy debate by students and professionals who will become future medical and health leaders. With delegates attending from around the world, this international conference has created professional development and networking opportunities. The organization follows the format and style of the WHO and is a valuable introduction to the structure and procedure of this international health organization for students interested in pursuing any career in healthcare and public policy.

