The White Paper

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STRENGTHENING MEDICAL RESEARCH WITH EVIDENCE BASED INFORMATION

SHAYONI RAY, PH.D

Introduction

Medical evidence can be presented in forms that are either anecdotal or based on objective, scientific evidences. Historically, verbal communications formed the basis of our earliest attempt to reveal and exemplify the efficacy of drugs and the stories were centered on the application, the success or the failure of the course of treatment. In order to better survive in a harsh untamed world, the collective knowledge stored in the human minds needed to be not only protected and maintained, but also continuously expanded in terms of how and why something worked and enumeration of the conditions, effects and probable reasons of failure. Anecdotal medical stories that have transcended culture and time have thus formed an important part of medical education for centuries (5). With the advent of modern technology and objective approaches to medical practice, more reductionist understanding of pathology and etiology of diseases have emerged, that prompted the rapid exchange of anecdotal evidence for evidence-based medical information.

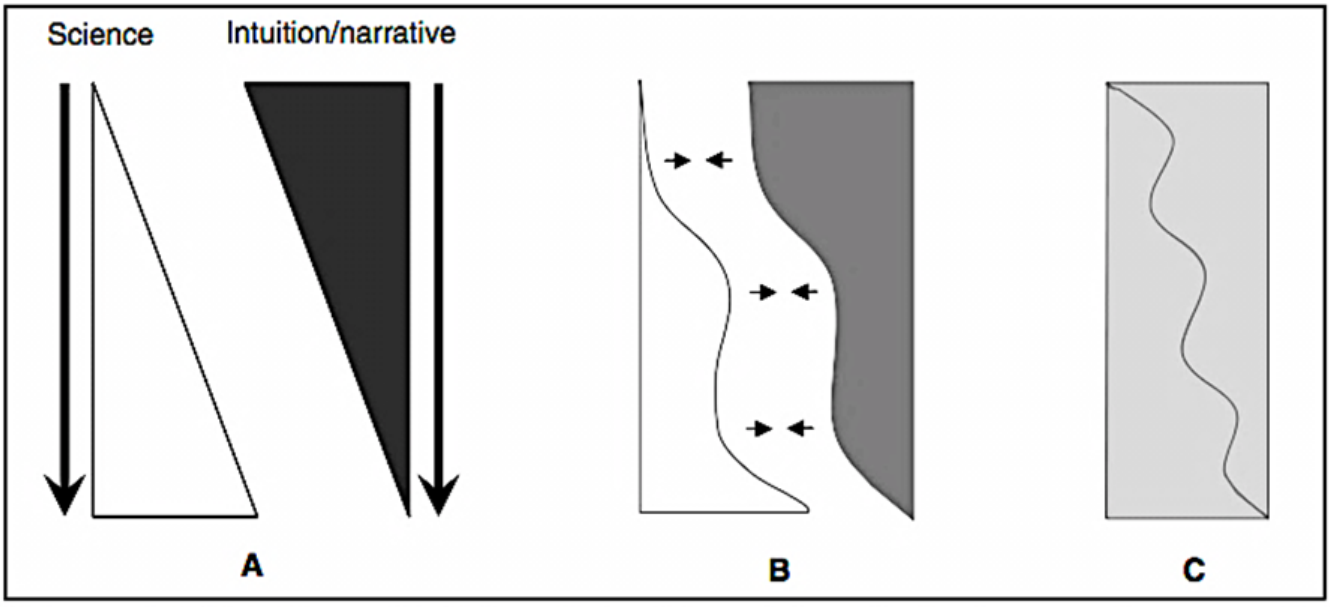

Figure 1: A diagrammatic representation shows the interplay between science and intuition/narrative in medicine. A) Shows the decrease in intuition/narrative in medicine with a concomitant increase in the scientific aspects. (B) and (C) show a blending of the scientific and intuitive/narrative aspects. (Adapted from: 5. Kosko, J., Klassen, T. P., Bishop, T., & Hartling, L. (2006). Evidence-based medicine and the anecdote: Uneasy bedfellows or ideal couple?. Paediatrics & child health, 11(10), 665.)

Anecdotal evidences, although unsystematic still have been the prominent influencer behind experiments involving population statistics (1).

The diagram in Fig.1 best explains this inverse relationship between experimental science and the intuitive and narrative aspects of medicine: Evidence-based medicine (EBM) was cited by The New York Times in 2001 as one of the critical innovative ideas of this era (5). While EBM marks a crucial advancement in informative medical history, the main issue resisting its full utility are the gaps that persist between availability of evidence and the application of recommendations and interventions in text books or journals (10).

This article deals with the limited merits and scientific demerits of anecdotal evidence and outlines the types and sources of seeking evidence -based information for a well-designed and comprehensive patient care.

Evidence-based vs. anecdotal stories in medical research

Various forms of medical evidences can be used as information enriching a medical story. The following diagram (Fig.2) shows the several types of medical communication and each one has its own merits and disadvantages.

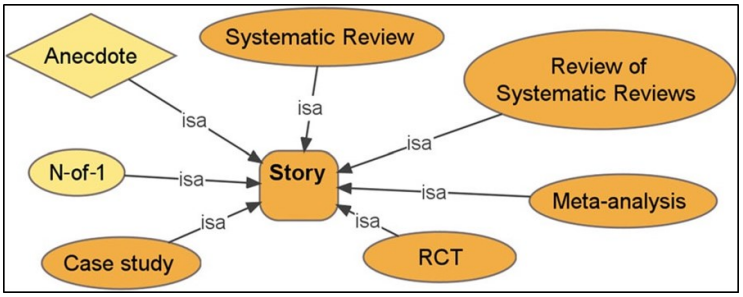

Figure 2: Story-related families of medical evidence (Adapted from: 1. Nunn, R. (2011). Mere anecdote: evidence and stories in medicine. Journal of evaluation in clinical practice, 17(5), 920-926.)

Anecdote: An anecdote is used as a narrative to communicate a particular patient's personal experience with a disease, its symptoms, their suffering and their efforts in treating it. Proponents of EBM consider anecdotal evidence as unsystematic and poor grounds for deducing scientific laws since they are not controlled, repeatable or generalizable. Anecdotes not only suffer from singularity and limited replicative features, their significance is often implied on the emphasized features. Specificity, plausibility and discernibility are the three features that are usually used to distinguish a relevant anecdote (1). Other than selective memory, below are some factors that make anecdotal medical evidence difficult to rely on (8):

Regression to the mean - a statistical occurrence where random chance regulates how periods of average variation follow periods of extreme variation. Hence when medical intervention is sought at a severe period, there will be incidences after this when the symptoms are not very severe.

Self-limiting nature of most illness – Most regular illnesses improve on their own. Hence in order to assess the usefulness of an intervention, it has to be compared with control or placebo treated cases.

Multiple treatments – Often general public will try different courses of treatment, either all at once or sequentially, making it impossible to deduce the efficacy of a certain path.

Reporting bias – Reporting bias exists in several common scenarios such as: experience of patients who died of an ailment are not considered, patients with better outcome are more likely to come back for a follow-up and talk and patients often do not narrate their experiences with any novel intervention.

Confirmation bias and vague outcome

measures – There is always a psychological bias, where patients seek or remember information related to their core beliefs and avoid other information. Most of the times, anecdotes contain subjective outcome measures, which not only introduces other variables but also act as confounding factors.

The placebo effect – Placebo effect comprises of a collection of several psychological factors, general behavior, stress etc. that renders a response to an intervention, ineffective.

Evidence-based studies

Evidence-based medical research emphasizes the evidences from clinical research while minimizing the role of unsystematic clinical experience, pathophysiology and intuitive rationale for making medical decisions (2). Over the years, EBM and evidence-based practice (EBP) have spearheaded clinical practice education, policy-making and scientific medical research (6). The several categories of EBM are outlined below:

N-of-1: Single subject clinical trials are designed to consider an individual patient as the sole unit of observation who participates in studies that investigate the efficacy, side-effect and treatment procedures of medical interventions. Based on the physician's ability to remotely monitor clinical end points in a cost-effective and timely manner, such individualistic trials have been routinely used in behavioral and psychological assessment settings with the exception of studies of pain medications. The N-of-1 trial results have been used to determine the best intervention in an individualistic approach using objectively defined, data-driven analysis (7). Single subject studies hold promise for developing individualized approach to medicine. Compared to anecdotal evidence that does not assume any particular method or ideology, N-of-1 trials have been designed to eliminate personal bias and other confounding factors (1).

Case study: Case studies are detailed narratives that reports individual cases involving unknown diseases or syndromes, cases displaying an important variation of a disease or cases where one patient has two or more unexpected diseases and finally, cases displaying unexpected events that may yield new or useful information. Although case reports are considered to be the lowest level of medical evidence, they are also considered as the first line of evidence illustrating the significance of observations regarding issues and ideas that will require further in-depth investigation. In case of multiple reports showing similar narratives, a case-control study can be conducted. Such a study will compare patients suffering from a disease (cases) with patients who are not suffering from that particular disease or outcome (controls) to assess the relationship between the risk factor and the disease. Case studies often help to identify unknown diseases or rare manifestations of known diseases, unknown side effects and potential adverse or beneficial effects. Since case studies are not systematic and cannot be generalized, observations always cannot be linked to associations with known causes. Lack of subjects can also lead to undue emphasis on the misleading elements (9).

Randomized control trial (RCT) – RCT is type of medical study design that randomly allocates patient population to either group - group receiving the treatment under investigation or group receiving standard treatment (or placebo treatment) as the control. RCT is designed to minimize selection bias in the outcome variable that is being tested, while other variables are kept constant. RCTs are generally used to test the adverse effects of drugs and other types of medical interventions. Such trials are useful since the results that are obtained from clearly defined patients, are statistically analyzable and the randomization is usually effective in removing population bias. Among the demerits of RCT, time

and financial burden are the biggest concerns along with volunteer bias where the participating patients may not represent the whole spectrum of affected individuals. Randomized trial results are also not very useful for issues in etiology, diagnosis and clinical judgments that are dependent on pathophysiologic changes, psychosocial factors and personal preferences for providing patient care and comfort. Although RCTs address the statistical relevance of an intervention, it often fails to answer critical questions regarding how and why the specific interventions worked (6, 9).

Systematic reviews: Such a review is written by a panel of subject matter experts and provides a comprehensive summary of information pertaining to clinical trials, evidence-based reports, scientific literature, medical findings and case studies – both published and unpublished. Systematic reviews are very detailed, less expensive and time consuming than conducting brand new studies. Although creating such reports are very time-consuming, the results are more reliable and accurate and can be applied to the general population, more than single subject study (9).

Meta-analysis: Meta analysis involves designing a systematic method for combining only the relevant qualitative and quantitative study data from several selected studies. The results help building a single conclusion that has been derived from increased participation and larger diversity among patients and their accumulated results. Meta-analysis can be used to develop a better estimate and more stringent analysis of safety data, benefits and adverse effects related to studies with conflicting results, studies with subgroups that are not statistically significant and studies combining several RCTs. Meta-analysis is considered to be an evidence–based source with higher ability and greater statistically power to be extrapolated to population. Due to the heterogeneity of study participants, meta-analysis requires the use of advanced statistical techniques in analyzing the diversity in data. Hence it is very time-consuming and sometimes difficult to identify and interpret appropriate studies. It should also be noted that, not all meta-analysis is able to provide adequately conclusive data (9).

Searching for evidence-based research

Evidence based research involves all high-quality recommendations that are pertinent to a certain intervention or condition. In the context of evidence, cases of Patient-Oriented Evidence that Matters (POEM) and Disease-Oriented Evidence (DOE) have been prevalent. Whereas POEM deals with the outcomes of treatment that are important to the patients such as fluctuations in morbidity, mortality and quality of life, DOE involves with surrogate end point, such as changes in clinical test results, lab tests and other objective responses. Although the POEM results have been observed to work in parallel with DOE results, they do not always correlate. For evidence-based research purposes, POEM results have been favored over DOE. High quality meta-analysis, expert opinion, RCT results with outcomes (POEM), clinical cohort studies, case-controlled studies or well-designed non-randomized clinical trials are the best ways to evaluate the strength and legitimacy of clinical literature (4). The following sources can be used to search for evidence-based medical information:

Agency for Healthcare Research and Quality (AHRQ), formerly known as the Agency for Health Care Policy and Research (AHCPR): Clinical Guidelines and Evidence Reports:
http://www.ahrq.gov/clinic

American College of Physicians Journal Club (ACPJC):
http://www.acponline.org/journals/acpjc/jcmenu.htm

Bandolier: http://www.bandolier.org.uk/

Centre for Evidence Based Medicine (CEBM):
http://www.cebm.net/

Continued on next page

Center for Research Support, TRIP Database:
https://www.tripdatabase.com/

Clinical Evidence, BMJ Publishing Group:
http://clinicalevidence.bmj.com/x/index.html

Cochrane Database of Systematic Reviews:
http://www.cochrane.org/

Database of Abstracts of Reviews of Effectiveness (DARE):
https://www.ncbi.nlm.nih.gov/pubmedhealth/about/DARE/

Effective Health Care:
http://www.york.ac.uk/inst/crd/ehcb.htm

Evidence-Based Medicine:
http://www.evidence-basedmedicine.com

Evidence-based database:
http://www.essentialevidenceplus.com/

Institute for Clinical Systems Improvement (ICSI):
http://www.ICSI.org

National Guideline Clearinghouse (NGC):
https://www.guideline.gov/

National Health Service (NHS) Centre for Reviews and Dissemination (CRD):
http://www.york.ac.uk/inst/crd/

Primary Care Clinical Practice Guidelines:
https://medicine.ucsf.edu/education/resed/ebm/practice_guidelines.html

U.S. Preventive Services Task Force (USPSTF):
http://www.ahrq.gov/clinic/uspstfix.htm

Adapted from: Siwek, J., Gourlay, M. L., Slawson, D. C., & Shaughnessy, A. F. (2002). How to write an evidence-based clinical review article. Am Fam Physician, 65(2), 251-8.

Conclusion

For scientific researches, the apparent goal is the generation of data and knowledge base that can be applied in times of need. However, healthcare differs from a purely scientific standpoint, since medicine involves the patients and their satisfaction and wellbeing needs to be considered over a physician's best efforts to provide evidence-based treatment. Finally, a patient with poor outcome rarely cares about the evidences that were used for the intervention. Since medicine is not just an abstract intellectual pursuit, factors such as finances, time and psychology disturb rational decision-making. Even with RCTs in view, it is not always helpful since the results cannot always be applied to patients whose profile does not match with that of the participating individuals in the trial (1, 3). Continuous efforts are being made so that a cost-effective, rational and holistic patient care can be obtained with treatment or intervention based on objective evidences (6).

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NEUROLOGY

THE SECRET LIFE OF SEROTONIN - A CLOSER LOOK AT A POWERFUL COMPOUND

STEPHEN HATEZ

At first glance serotonin appears to be a simple molecule and its role is well defined in textbooks. Every student of EMS learns that serotonin is a neurotransmitter which regulates the central nervous system and plays a role in mental health. What every student doesn't learn, however, is that serotonin also leads a complex secret life.

In fact, only about 10% of the serotonin that in the body is even located in the brain: 90% of the body's serotonin is in your stomach (also 50% of the body's dopamine is found in the stomach). The enteric, also called the intrinsic, nervous system is a vast neural network spread across the stomach and intestines to regulate to activity of digestion. The enteric nervous system is made up of over 500 million neurons. In comparison, the spinal cord only has 100 million neurons. The enteric nervous system is so complex that it considered completely separate from the central and the autonomic, meaning that the body has three primary nervous systems. Research has shown that if the link between the enteric nervous system is severed (it mostly communicates by way of the vagus nerve) it will still continue to function, regulating its own behavior by way of serotonin, thus the need for such high amount of this neurotransmitter to be present in the stomach.

Physiology

As to the mechanics of serotonin, in the stomach it is stored in a specialized cell called an enterochromoffin cell. In the brain, it is synthesized in cells referred to as seratonergic cells. To regulate signals serotonin is secreted out of a presynaptic nerve ending into the nerve synapse where it then crosses and binds to a postsynaptic receptor, just like crossing a river to flip a switch. To turn off the switch, a chemical transporter is used to collect the serotonin (through a process known as re-uptake) and transport it out of the synapse and back inside the presynaptic nerve.

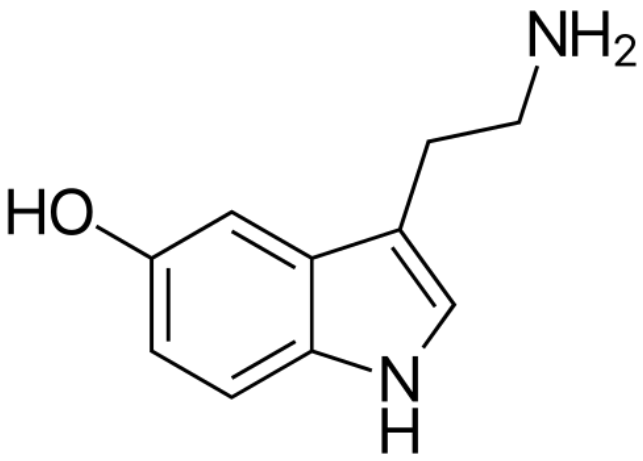
From this mechanism of action we get the term selective serotonin reuptake inhibitors, or SSRI's. These are a class of anti-anxiety and anti-depression medications blocking the reuptake of serotonin to increase its concentration at the postsynaptic receptors. This model operates on the theory that more serotonin lead to more serotonin binding to receptors, in turn leading to a more positive effect on a person's mood. Mood, it appears, is linked to the presence or absence of serotonin. Common doctrine on depression states that low levels of compounds such as serotonin are the cause of depression and can exacerbate anxiety.

The mechanics of serotonin are comparable to the behavior of other signaling

compounds. Cocaine, for example, blocks a compound called DAT, or Dopamine Active Transporter. DAT controls the re-uptake of dopamine and by blocking it and concentrations in the brain can skyrocket (dopamine doesn't cross the blood brain barrier which is why its safe for shock patients) leading to pleasure.

Chemistry

The series of receptors activated by serotonin are referred to as the 5-HT series, or 5-hydroxytryptoamine. These receptors, once stimulated, modulate a wide range of physiological functions including controlling Cyclic-AMP concentrations, releasing messengers such as epinephrine and norepinephrine and the secretion of hormones such as oxytocin and prolactin. The 5-HT designation is derived from the chemical structure of serotonin, as seen below:



5-hydroxy' referring the position of the 'OH' group on the larger ringed structure on the left (counting each point of the ring clockwise from the 12-o'clock position). The phrase 'trypto' refers to the fact that serotonin bears a strong resemblance to tryptophan. This is the origin of the now disproven notion that turkey, loaded with tryptophan, could cause sleepiness by increasing serotonin levels. Tryptophan is a chemical precursor to serotonin as well as a precursor to melatonin, a popular over-the-counter sleep aid.

The phrase 'amine' refers to the NH(2) group at the top right. Since there is only one amine group serotonin falls under the category of being a monoamine. MAOI's, or monoamine oxidase inhibitors, block the actions of the chemicals in the monoamine category. This is the reason why caution is exercised with MAOI's. If a person were to take multiple medications which blocked the uptake of serotonin causing levels to rise very high, a condition known as Serotonin Syndrome might occur.

Serotonin-Related Illness

Serotonin Syndrome achieved widespread attention in 1984 when an 18 year-old college student named Libby Zion died in a New York City hospital. Her treating physician accidentally prescribed medication which led to a fatal increase in her serotonin levels. During a related court case, the lack of proper rest was cited a a causative factor. This led to the present day limits on the working hours of medical interns and residents.

Serotonin Syndrome is a constellation of symptoms ranging from high fever, tremors and sweating to seizures and muscle destruction. Symptom onset is usually immediate following a critical increase in the concentration of serotonin in the brain, and occurs when two or more seratonergic medications are combined or in instances of drug use. The condition appears in 15 percent of SSRI overdoses, so the paramedic should be attentive to these symptoms when presented with a patient who has taken an excess of SSRI antidepressants. St. Johns Wort, tricyclic antidepressants (TCA's), cocaine, amphetamines, tramadol and dextromethorphan (found in cough syrup) have also been known to precipitate Serotonin Syndrome.

Diagnosis is often difficult and is based on the patient's history and past drug or medication use; No laboratory test exists. A plethora of other conditions such as meningitis, viral infection and

heat stroke must first be ruled out. Treatment is directed at the discontinuation of any contributing medications, the use of benzodiazepines, cooling the patient down and possible, the use of serotonin agonists.

On the other end of the spectrum, a condition called 'Antidepressant Discontinuation Syndrome' can occur following the discontinuation or reduction of dose of a medication designed to raise serotonin levels. Patients can experience flu-like symptoms and insomnia. Most cases are mild and don't require treatment. In severe cases, re-introduction of the antidepressant is used and then the patient is gradually weaned off the drug.

Sudden Infant Death Syndrome, or SIDS, is also linked to serotonin. Research has demonstrated that low levels of serotonin hamper signaling in the cardiac and respiratory centers in the brainstem. This impaired signaling is thought to be the cause of SIDS.

The Effects of Serotonin

Serotonin truly wears many hats. One of its lesser known roles is the regulation of hunger. When humans smell food, dopamine is released to increase the appetite (thus the concept of comfort food). Serotonin halts the release of dopamine decreasing the sensation of hunger. SSRI medication blocks this process, confusing the body until it can't determine the true hunger level or if it needs nutrients. This leads to weight gain, a typical side effect of antidepressant medication.

Another side effect, stomach-aches, can be linked to the action of serotonin within the enteric nervous system. If irritants are present in the stomach, serotonin levels are increased to speed up the digestive process and empty the gut (leading to another side effect: diarrhea). Serotonin also causes the stomach to contract, leading to cramping.

5-HT3, a serotonin receptor subtype of the 5-HT class, is found in the vagus nerve and is responsible for causing vomiting. 5-HT3 antagonists, those blocking the activity of serotonin, are considered the be the first line in the treatment of nausea and vomiting. A classic example is the use of ondansetron (Zofran).

Outside of the brain and stomach, serotonin binds to platelets and, when transported to the site of an injury, it acts as a local vasoconstrictor. Serotonin also acts as a growth factor, stimulating various cellular repair mechanisms. Serotonin regulates bones and increased serotonin levels can predict low bone mass.

Consumption of alcohol causes lower in serotonin levels and this decrease is considered to be somewhat responsible for the impulsive behavior associated with intoxication. Similarly, the phenomena of falling in love causes decreased serotonin levels, which is why new lovers display obsessive behavior (decreased serotonin also causes obsessive-compulsive disorder).

Mental Health

Mental health is unfairly stigmatized due to a lack of education. The effects of depression, anxiety, obsessive-compulsive disorder and many others, have roots in impaired cellular signaling. If it is acknowledged that love is moderated by neurotransmitters such as serotonin, it must also be acknowledged that when these neurotransmitters break behavior can be adversely effected. The brain is simply an organ just as any other and is prone to defect.

Mental health stigma is a 'gut reaction' to a problem which is more about the concentration of chemicals that about the patient's character. Aberrant behavior caused by low levels of glucose certainly isn't considered a reflection of character. Likewise, aberrant behavior caused by low levels of serotonin shouldn't be either. A physiological basis exists for these conditions. As with the life of serotonin, there is far more to the mental health puzzle than meets the eye.

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Writer Bio

NEUROPSYCHOLOGY

TAGGING AND MANIPULATING PAINFUL MEMORIES THROUGH OPTOGENETICS

ALBERTO MOLANO, M.D., PH.D.

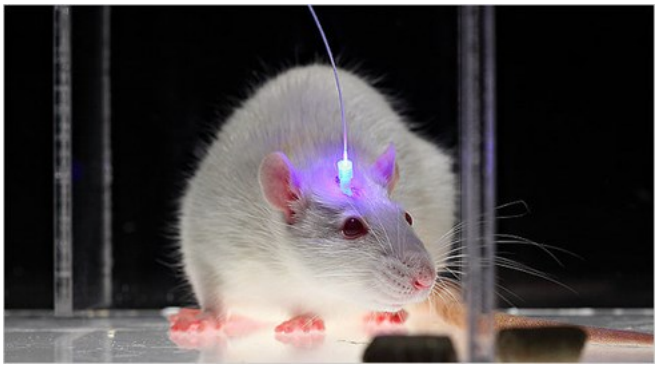


Image courtesy of Karl Deisseroth

A technological breakthrough, optogenetics, is allowing scientists to tag and manipulate memories in laboratory animals with beams of light, opening new avenues to understand disorders such as PTSD and perhaps to treat them more effectively in the future.

When the call came at 1 AM, Mike was not pleased. Bowdoin-Geneva, intoxicated male, possible methamphetamine toxicity. A potentially out of control, aggressive, delusional, screaming, biting, punching, vomiting patient. As he and his partner rushed to the scene in this Boston neighborhood, Mike slipped on his reflective vest. The dim streetlight revealed a 20-30 year old extremely agitated man. He ran to the middle of the street, clenched his fists, screamed, stretched his arms up to the sky, lied down on the pavement and pretended to swim, held his knees and made rocking motions, then jumped up and massaged his head. No one else could be seen around.

Weren't we called several months ago to this same neighborhood in response to the same patient? Let's park here and wait for the police. Did you check with the dispatcher? Turn off the lights.

Distracted by the freaky movements of the intoxicated man, they never saw it coming. The confusing simultaneity of the loud detonation, the glass breaking, the sudden rush of cold air, anteceded any possible logical inference. Mike felt an excruciating burning sensation and hot blood pouring down his right side. God, did something just hit me? Where? He watched the panicked response of his partner as in a silent film due to the loud ringing in his ears. Did someone just shoot us? Where? Are you OK? I think I just got shot on my shoulder. The burning pain ebbed and flowed with the synchronicity of Mike's heartbeats. Turn on the engine… turn it on now!

This incident ruined Mike's professional life. Although his physical wounds were never life-threatening, he started experiencing vividly disturbing nightmares, intrusive flashbacks and an overwhelming phobia to ambulances and paramedic uniforms. It was so strange to realize that even the common tools of his trade had become imbued with such a disgusting feeling.

It suddenly dawned on him that he had completely lost any desire to return to work.

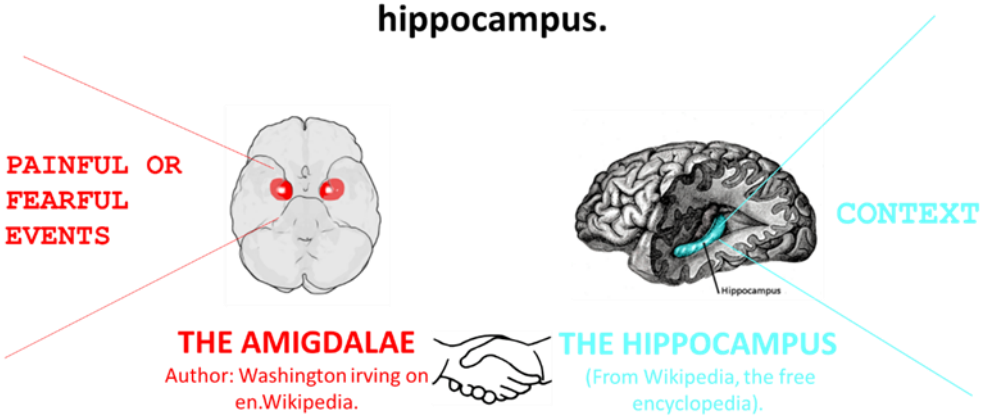
Mike wondered: what is going on inside my

mind? I wish I could just turn off these painful memories with the click of a switch. Or even better, what if you could somehow magically transform these painful memories into pleasant ones?

Unbeknownst to Mike, scientists at MIT, just across the Charles River from EMS headquarters, have been attempting what seems like science fiction. Using laboratory mice, a team of researchers headed by Dr. Susumu Tonegawa, winner of the 1987 Nobel Prize for Medicine or Physiology, are learning how to tag painful memories in real time in order to be able to manipulate them with beams of light.

Scientists already have a fairly good, albeit general idea, of where unpleasant, emotionally charged memories are encoded and stored. They know that two structures inside the brain, known as the amygdala and the hippocampus, play critical roles. A painful memory has two separate but interconnected parts. One part involves the painful or fearful events themselves, the other part involves the context in which those fearful events occurred. In Mike's case, the fearful parts of the memory include events like the loud detonation, the excruciating burning sensation and the feeling of hot blood pouring down his right side. The contextual parts of the memory encode information on the setting in which the incident took place: the ambulance, the paramedic uniforms, his partner, sounds coming out of the ambulance radio, the emergency medical equipment inside the ambulance. Scientists know that the fearful, emotionally charged components of a memory are encoded in the amygdala, which connects with brainstem areas that control the heart and respiratory rates, blood pressure and fight or flight responses. In contrast, the contextual elements are stored in the hippocampus. A painful memory is encoded completely when both sets of components get linked: when the fearful components stored inside the amygdala hold hands and interconnect fingers with the contextual information stored inside the hippocampus. Scientists also know this link is not static or irreversible.

Two structures that encode painful memories: the amygdala and hippocampus.



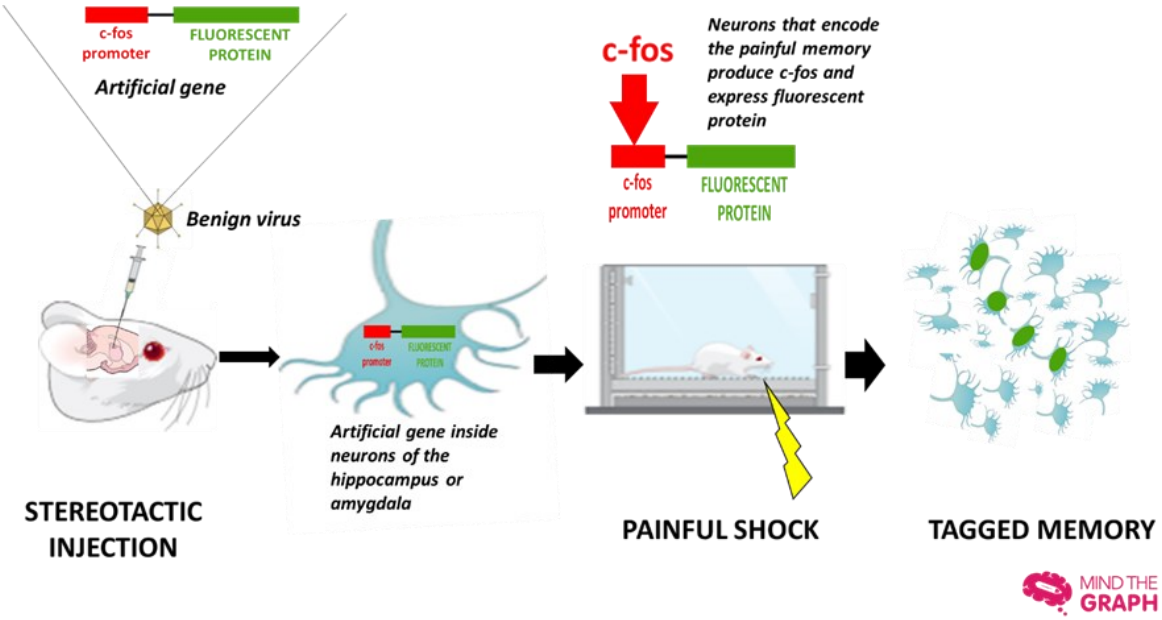
The first step to try to correct what is incapacitating a PTSD patient is to be able to pinpoint and understand its exact origin. But how can you tag something as fleeting and insubstantial as a specific painful memory? The whole idea seems farfetched. The amygdala and the hippocampus each contain millions of neurons. Presumably, a distinct painful experience, like Mike's, is encoded somewhere inside his amygdala and hippocampus. But which of those millions of neurons, which look exactly identical under a microscope, encode that particular painful memory? How can you test that? It is like trying to find a group of coordinated malicious hackers (the unpleasant memory) in two American cities. The police already know that the hackers live in Boston and Philadelphia (the hippocampus and the

amygdala). But Greater Boston has a population of 4.7 million and Philadelphia 1.5 million. How can you tell who the hackers are amongst millions of residents?

In addition, encoding an emotionally charged memory takes just a short period of time, a fleeting moment. Only while it is being actively experienced (or perhaps, vividly remembered) can scientists try to identify the neurons responsible for encoding it. Once the painful experience (or perhaps its remembrance) subsides, it is next to impossible. Like criminals, these neurons have to be caught in flagrante delicto. Luckily, memory is not insubstantial: while a painful memory is being encoded, there is a very substantial spike in the firing activity of the neurons that are working to encode it. And this increased firing activity leaves a temporary trace behind, in much the same way that an office employee working overtime can be detected because the lights in his office cubicle are turned on longer than usual or his consumption of office supplies goes up.

Neurons which increase their firing activity during the encoding of a specific memory transiently increase their synthesis of a transcription factor called c-fos. Transcription factors are proteins that can turn on specific genes by binding to specific DNA sequences called promoters. Scientists believe that neurons which “fire together wire together”. In other words, a small number of them will “team up” and strengthen their connections to encode a specific memory, and neurons increase c-fos synthesis in order to turn on the genes they need to strengthen those connections.

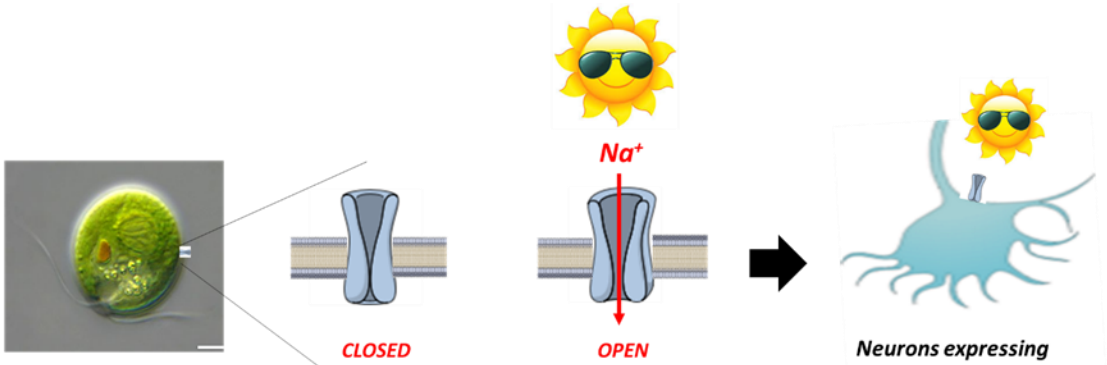
Scientists have learned how to use this increased c-fos synthesis, this temporary trace of cellular activity, to individualize the sparse network of neurons that encode a distinct memory in laboratory mice. This is achieved by constructing artificial genes and introducing them inside the neurons of the amygdala or hippocampus. In these artificial genes, the c-fos promoter drives the expression of whatever gene the scientists choose. It can encode, for example, instructions for making a fluorescent protein that will tag the activated neurons. The artificial genes are packed inside benign viruses, which are commonly used for human gene therapy clinical trials, and these viruses are injected directly into the amygdala or hippocampus of anesthetized mice by means of stereotactic injections. The viruses then infect the neurons and introduce the artificial genes. Later on, when mice are exposed to a painful experience, the neurons of the amygdala or hippocampus that encode that memory produce c-fos and can be fluorescently tagged.



Memories now look like a string of fluorescent pearls under the velvety darkness of the microscopic field. Using these techniques, scientists have learned, for example, that deep inside the entangled mesh of millions of neurons of the hippocampus, only about 2-4% of those that reside in a part known as the dentate gyrus are tagged during the encoding of a specific memory. If the laboratory animals are exposed to the same experience, by and large the same neuronal population will be tagged, but if the context changes, the activated neuronal population also changes. However, these are just dead fluorescent neurons under a microscope. How can you tell what they really do inside a living brain? In other words, scientists have to prove somehow that the tagged neurons really encode the distinct memory the mouse experienced while still alive. But how can you do that? This would require transiently activating only the tagged neurons in a living, freely moving mouse without disturbing adjacent neurons. If you were able to do it, would specific stimulation of those neurons cause the animal to relive the painful experience? More importantly, is there a way of manipulating those neurons to modify that specific painful memory or to extinguish it altogether? This is not easy. It is like trying to touch only a few wasps out of the tens of thousands inside a nest without disturbing the remaining wasps. Any stimulus can spread like wildfire. Traditional tools like electrical impulses or drugs cannot accomplish this. Although electrical impulses can activate neurons with the required speed, they are totally nonspecific: an electrical impulse will spread in an instant, activating entire populations of neurons. Drugs, on the other hand, are too slow: even if scientists could design a drug with the required specificity, it would take time for it to reach its target. What you need is something that is very fast, like electricity, or the shot fired at Mike's ambulance, but unobtrusive and exquisitely specific.

The answer turned out to be light.

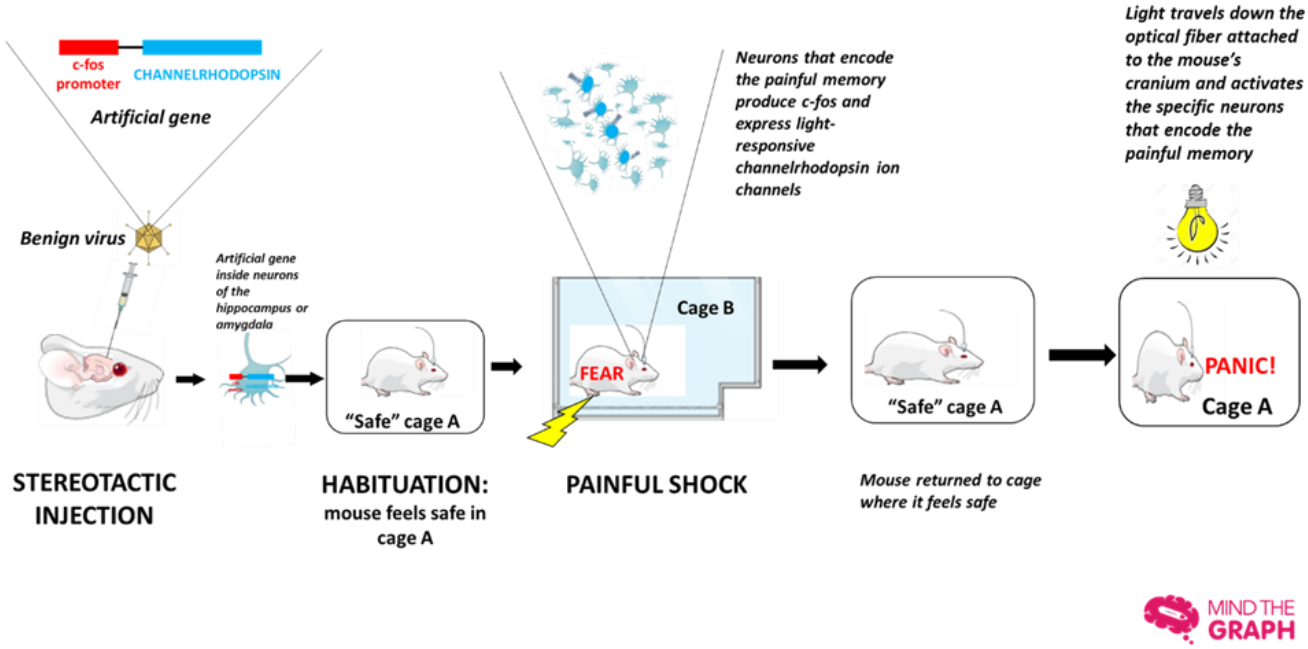
It turns out there is a small, single cell green algae called Chlamydomonas reinhardtii. It is just slightly larger than a human red blood cell and has two flagella that allows it to swim towards sunlight. In order to know which way it needs to swim, it has light-responsive ion channels called channelrhodopsins on its membrane. These are proteins that regulate the flow of specific ions in response to photons. When light shines on them, they open and allow these ions to go inside the algae. Interestingly, a very similar process takes place when neurons become activated: protein channels open, allowing positively charged sodium ions to rush in. Of course, ion channels in neurons do not respond to light. But scientists wondered what would happen if they inserted light-responsive ion channels from Chlamydomonas on the membranes of neurons in the laboratory.



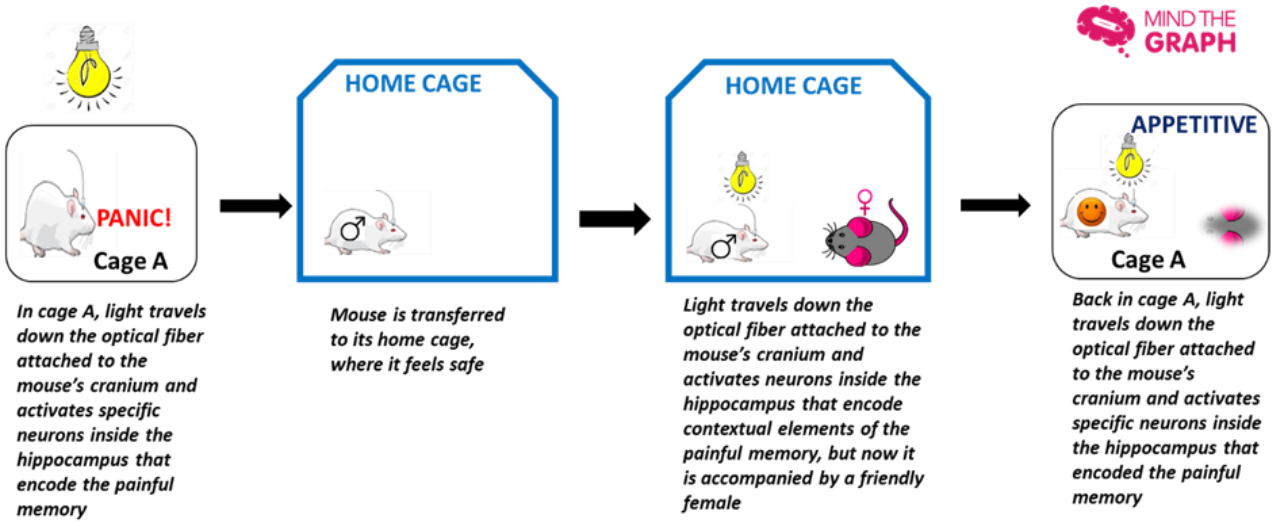
Would they respond to light? The answer turned out to be yes: each time a beam of light of the correct wavelength shone on neurons expressing channelrhodopsin on their membranes, they fired.

The functional expression of light-responsive ion channels from microscopic algae by neurons permitted the emergence of optogenetics: the revolutionary technique that allows scientists to transiently and unobtrusively activate the sparse population of neurons that are tagged while a living animal experiences a painful stimulus without disturbing adjacent neurons. By linking the channelrhodopsin gene to the c-fos promoter and virally delivering the construct into the amygdala or hippocampus of mice, any neuron that becomes activated and expresses c-fos while the animal memorizes a painful situation will also express channelrhodopsin and become light-responsive. To be able to shine a beam of light over the tagged neurons inside the amygdala or hippocampus of mice, a very thin optical fiber is precisely inserted into their cranium immediately following the stereotactic injection of the virus and the optical fiber is connected to a laser beam.

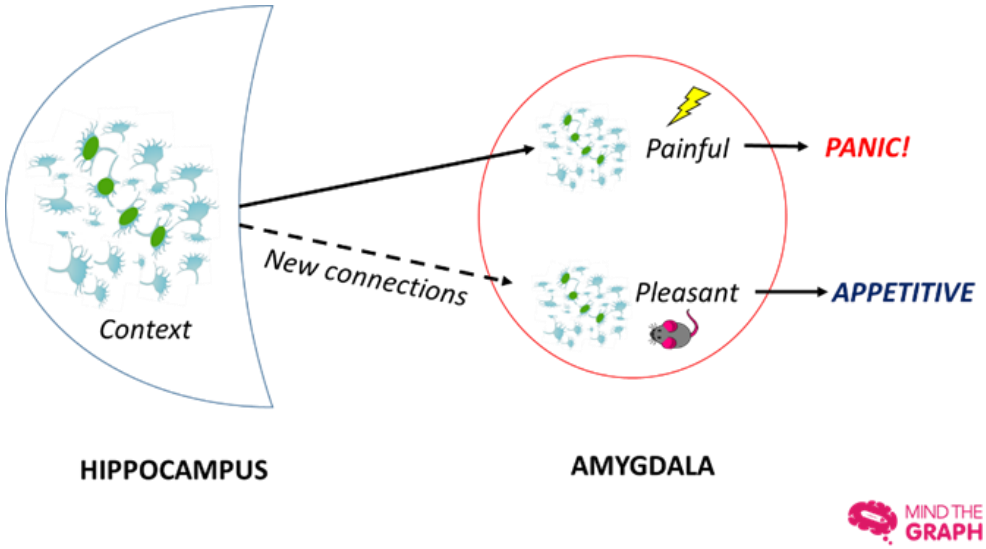
So what happens when scientists turn on the light? A painful memory has two parts, the painful event itself and the context in which it is experienced. In these experiments, the painful event is a mild electric shock, while the context is represented by different cages. The mice can be transferred to different cages in order to modify the context. In a typical experiment, mice are first allowed to become habituated to a "neutral" cage, let's call it cage A. They are allowed to explore cage A for several days, until they feel they are safe in cage A. The animals are then transferred to a different cage, called B, which is the fear-conditioning cage. Cage B is usually scented with a certain chemical substance so that the mice can sense they are in a different context. In this cage they are given brief electric shocks which frighten the mice and which leave behind a painful memory that is encoded in their amygdalae and hippocampi. Here, the network of neurons that work to encode that specific memory produce c-fos and express channelrhodopsin on their membranes. These fear-conditioned mice are then returned to cage A, with their neurons already expressing channelrhodpsin and having become sensitive to light stimulation. Since they are already habituated to cage A and know it is safe, the mice relax. However, as soon as the switch is turned on and light travels down the optical fiber into the mice's amygdalae or hippocampi, they freeze in panic, indicating that the tagged neurons indeed encode the painful memory.



Scientists are also beginning to understand how to modify this panic response. In another set of experiments, fear-conditioned and channelrhodopsin-labeled animals are transferred to their home cage, where they feel safe, and allowed to interact with female mice at the same time that light is being shined into their hippocampi. The objective here is to reactivate the contextual parts of the painful memory engraved on their brains at the same time that the mice experience a pleasant sensation, that of interacting with females. Surprisingly, when scientists "turned on the light" in these mice in the neutral, testing cage A, they no longer froze in panic. Quite the opposite, mice exhibited a so-called appetitive response, in which the animals assumed that a friendly female was nearby and started looking for her.



These results confirm that memories, even painful ones, are not irreversibly etched in the mind. They are dynamic and changeable. The emerging picture of a painful memory is one in which the neutral, contextual components are encoded in the hippocampus while the fearful, emotionally charged components are stored in the amygdala. Both components hold hands and interconnect fingers to encode that memory, but the hippocampus is free to choose who to hold hands with. If subsequent experiences indicate that that context is also associated with rewarding feelings, the hippocampus will change partners and strengthen the connections with a different, pleasant memory in the amygdala.



Optogenetics opens up a myriad of possibilities to understand and experimentally manipulate painful memories. Scientists now have at their disposal light-responsive ion channels which do exactly the opposite of what channelrhodopsin does: instead of activating neurons, they inhibit them by allowing the passage of negatively charged ions. In theory, a fear-conditioned mouse expressing these inhibitory ion channels and frozen in panic because it is being forced to confront the source of its fear would become fearless in an instant by just switching on the light.

The first step to try to correct what is incapacitating a PTSD patient is to be able to pinpoint and understand its exact origin. With optogenetics this objective is finally becoming a reality.

ONE FINAL NOTE: certain technical steps involved in the optogenetics experiments were omitted for the sake of clarity. For full details and additional information please see below:

1. Optogenetic stimulation of a hippocampal engram activates fear memory recall. Nature 484, 381–385 (19 April 2012) http://www.nature.com/nature/journal/v484/n7394/full/nature11028.html
2. Bidirectional switch of the valence associated with a hippocampal contextual memory engram. Nature 513, 426–430 (18 September 2014) http://www.nature.com/nature/journal/v513/n7518/full/nature13725.html
3. Steve Ramirez and Xu Liu: A mouse. A laser beam. A manipulated memory. https://youtu.be/EXo3qA9V3eI

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NEUROLOGY

INTRACRANIAL ANEURYSMS: RIGHT TECHNIQUE AND TEAM REQUIRED FOR OPTIMAL OUTCOME

CHRISTIANNA L. REEDY, MS

Evolving Treatment for Cerebral Aneurysms

The treatment of cerebral aneurysms has undergone a dramatic shift towards endovascular therapy (mainly coiling) from the historically utilized microsurgical treatment (namely clipping) over the past 2 decades (Figure 1). Between 2000 and 2010, data collected from Medicare indicated the annual rates of coiling of unruptured intracranial aneurysms (UIAs) grew from 0.3 per 100,000 to 4.3 in 2010.1 During that time span, the rate of Medicare patients who underwent clipping for UIAs remained relatively stable at about 1.5 per 100,000 Medicare beneficiaries.

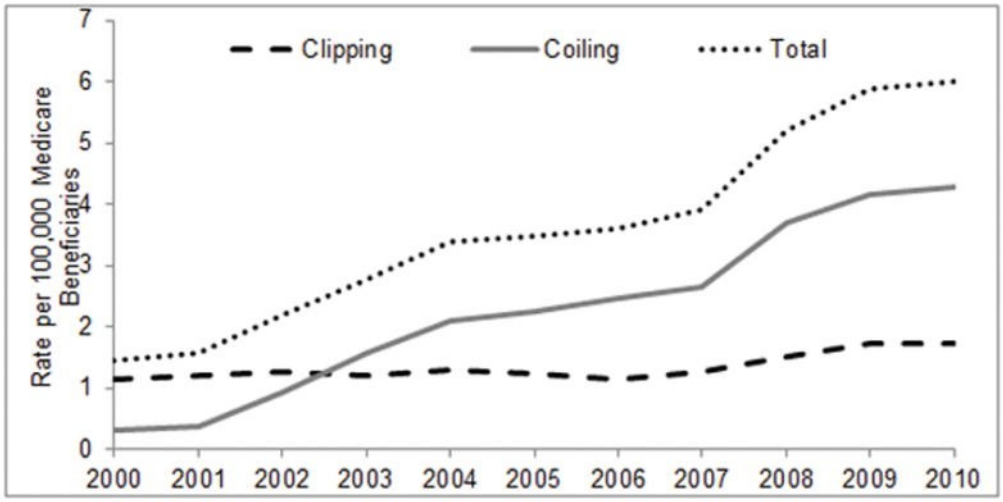

Figure 1: Rates of Clipping and Coiling of Unruptured Intracranial Aneurysms per 100,000 Medicare Beneficiaries, 2000–2010[1]

Coiling is an endovascular therapy in which coils, generally made of platinum, are inserted into the sack of the aneurysm in order to initiate scarring over the aneurysm, preventing it from filling with blood. This is accomplished through the use of a microcatheter. In contrast, microsurgery clipping utilizes one or more metal clips to physically close the aneurysm. This requires the skull bone and working under or around the mass of the brain. While clipping has been shown to be durable effective for some aneurysms, coiling is often viewed as a more attractive procedure because it is less invasive and requires less time.2

While initial studies suggested that, statistically, coiling produced better outcomes that clipping,3 recent studies support that the patient's treatment should be dictated by the

aneurysm's size, shape, orientation, and location in the brain, in addition to other patient factors. The evolving understanding of this field has the potential of impacting every level of medical practice.

Patient factors that Should Influence Treatment

Aneurysms that are located in certain areas of the brain can pose greater risks for microsurgical intervention, and are therefore better candidates for coiling than for clipping.4 Even in locations of the brain that are usually amenable to clip ligation, aneurysms may be better candidates for coiling due to local factors, such as perforating vessels or an orientation that does not allow for good visualization and access. However, the literature suggests that many areas of the brain a serviceable for clip ligation procedures. One such area is the subarachnoid space. A recent meta-analysis of 3 randomized, controlled trials and 16 observational studies on the treatment of high-grade aneurysmal subarachnoid hemorrhage (aSAH) found that coiling did not produce superior postoperative results compared to clipping. Additionally, clipping of aSAH had a lower mortality rate.

Physical aspects of the aneurysm itself also influence the preferred treatment. Very large aneurysms,5 very small aneurysms,6 and aneurisms with dome-to-neck ratios of <1.2 are often good candidates for clipping (Fig. 2).7 On the other hand, aneurisms with dome-to-neck ratios of >1.6 usually can usually be treated with coils without adjunctive techniques. Coiling is often preferred for aneurysms with calcified necks as well (Fig. 3).2 These are just a sampling of the aneurysm's physical factors that must be considered when selecting a treatment

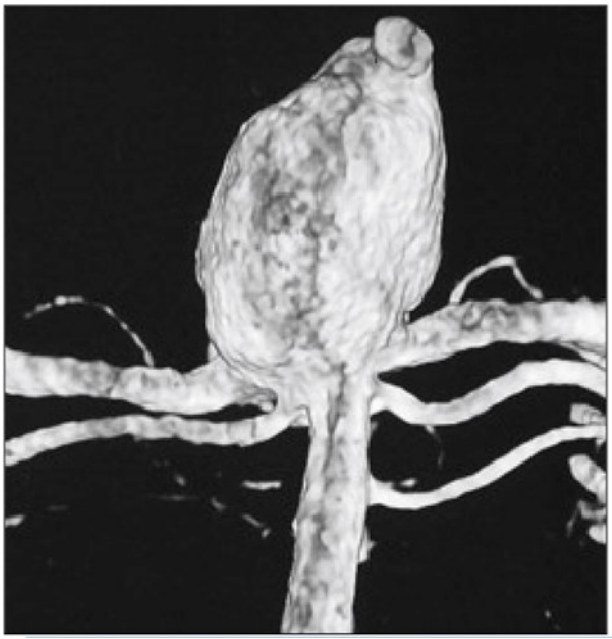

Figure 2: 3D angiogram in the anterior-posterior projection demonstrating the wide-necked nature, involving both proximal posterior cerebral arteries. This aneurysm was successfully treated by clip ligation.[2]

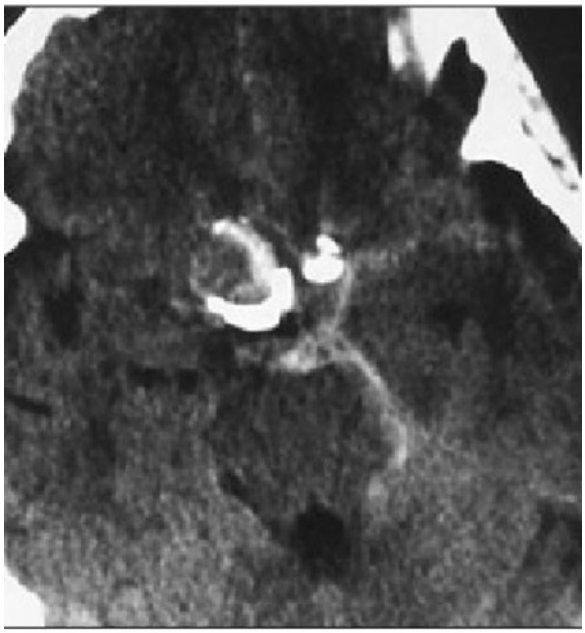

Figure 3: Axial computed tomography scan demonstrating significant calcification of a distal internal carotid aneurysm.

The age of the patient is an important consideration in the treatment of cerebral aneurysms. Because they cannot tolerate intracranial surgery as well as younger patients, elderly patients are considered much better candidates for endovascular coiling than for clipping.2,9 This rule generally applies in cases of both unruptured and ruptured aneurysms.

One patient factor over which some surgical practitioners have expressed concern is patient preference on treatment. In a letter to the editor, doctors Hakeem J. Shakir and Elad I. Levy wrote that, in their experience, patients were more inclined to choose endovascular coiling over microsurgical clipping even when their long-term health might be better served by clipping.10 In these cases, surgeons face the challenge of effectively communicating the risks of coiling against the risks of intracranial surgery, a procedure that may seem to have more obvious dangers and cosmetic disadvantages.

Care Provider Factors that Can Impact Patient Outcomes

The complex factors that affect the outcome of these 2 procedures would suggest that patients with cerebral aneurysms would be best served by facilities and medical teams with expertise in both clipping and coiling, and the research bears this out.

A 2003 study accessed how outcomes of aneurysm clipping were impacted by the patient volume experienced by the hospital where the procedure was performed.11 Researchers accessed the Nationwide Inpatient Sample to analyze data from 12,023 patients who underwent clip occlusion of a cerebral aneurysm from 1995 through 1999. Hospitals with very low patient volume demonstrated statistically significantly higher mortality rates than very high volume hospitals for aneurysm surgery, both emergency (14.7% compared with 8.9%) and elective (9.4% compared with 4.5%).

Another study, published in 2016, analyzed the effect of the neurosurgeon's experience or inexperience on clipping outcomes.12 Researchers analyzed the outcomes of 538 consecutive ruptured or unruptured intracranial aneurysm surgeries performed on 501 patients who were treated at Chang Gung Memorial Hospital-Linkou 1997 to May 2003. The "experienced" group comprised 2 neurosurgeons who had more than 10 years of neurovascular surgery specialty and who performed the procedure at least 20 times annually. The "inexperienced" group was composed of 16 neurosurgeons who had clipped less than 30 aneurysms prior to the study who performed the procedure at most 5 times annually. Analysis indicated that the inexperienced neurosurgeons were almost twice as likely to have poor outcomes as the experienced neurosurgeons.

While these studies focus on clipping exclusively, research is beginning to emerge that analyzes how outcomes of both clipping and coiling procedures are affected when they are performed by neurosurgeons who are highly experienced in both clipping and coiling. One such paper published in 2016 analyzed the outcomes of 252 patients with ruptured aneurysm who underwent clipping or coiling performed by one dual-trained vascular neurosurgeon between July 2010 and April 2015.13 When the outcomes of the 70 patients who underwent clipping were compared to those of the 182 patients who underwent endovascular treatment, there was no significant difference in mortality modified Rankin Scale score at first or latest follow-up. The study's authors concluded that ruptured aneurysms are best treated by a medical team equipped with both clipping and coiling expertise. Having expertise in both complimentary tools would aid in the assessment of patient and aneurysm characteristics and lead to optimal patient outcomes, the authors argued.

Conclusions

While more research should be done to assess the value of dual-trained vascular neurosurgeons for the treatment of cerebral aneurysms, the American Heart Association/American Stroke Association encourage healthcare professionals to treat patients with aSAHs at high-volume center when possible.14 These institutions argued in their 2012 Guidelines for the Management of Aneurysmal Subarachnoid Hemorrhage that high-volume centers with experienced cerebrovascular surgeons, endovascular specialists, and multidisciplinary neuro-intensive care services were preferable for the treatment of aSAH low-volume hospitals. First responders should be cognizant of the symptoms of ruptured cerebral aneurysms, such as a sudden, intense “thunderclap” headache, as well as nearby centers that are best equipped to treat them.

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PEDIATRICS/NEUROLOGY

THE INCIDENCE OF STROKE IN PEDIATRIC POPULATIONS

KRISTEN RYAN

A cerebrovascular accident, also known as a brain attack or more commonly a stroke, is caused by lack of oxygen to a specific region of the brain (PubMed, 2017). Lack of blood flow, and therefore lack of oxygen, can be caused by a rupture or obstruction of blood vessels supplying the brain, which results in sudden death of brain cells in the affected region. There are two main types of stroke; ischemic which is more common, and hemorrhagic. According to the Merriam-Webster medical dictionary, an ischemic stroke occurs when an artery leading to the brain is blocked usually due to a blood clot (2017). Another condition similar to an ischemic stroke is a transient ischemic attack (TIA), or mini-stroke, in which the blood flow is only blocked for a short time, causing less damage. The other major type of stroke, hemorrhagic stroke, occurs when an artery in the brain ruptures or starts to leak blood, building pressure and damaging brain cells (NIH, 2017). Cerebrovascular accidents are a major cause of death in the United States and around the world. They not only affect adults, but also affect the pediatric population.

Stroke in the pediatric population is one of the top 10 causes of death and is largely triggered by pre-existing conditions, (American Heart Association (AHA), 2017). According to the AHA, some of the most common pre-existing conditions contributing to pediatric stroke are;

- Sickle cell anemia, congenital heart disease, acquired heart disease
- Head and neck infections (meningitis) or trauma
- Systemic conditions such as inflammatory bowel disease or auto-immune disorders
- Dehydration
- Maternal history of infertility
- Maternal infection of fluid surrounding the baby
- Pre-mature rupture of membranes during pregnancy
- Maternal pre-eclampsia (dangerously high blood pressure)
- Other conditions such as genetic mutations and genetic diseases affecting blood clotting also contribute to pediatric stroke (Barreirinho et al. 2003).

The pediatric population affected includes babies in-utero, infants, children and young adults. However, it appears in the table below, which shows population statistics per 100,000 hospitalizations in patients between 30 days and 20 years of age, that the incidence of stroke peaks prior to four years of age, and then again between 15-20 years of age (Lo et al. 2009). It also appears that rates of stroke are increased in male populations and that

ischemic stroke is the most common across all age groups and gender/ethnic sub-groups. (Lo et al. 2009).

Table 2. National Estimates and Rates of Stroke-Associated Hospitalization for Children Aged Over 30 Days and 20 Years or Less[a]

A. National Estimates and Rates per 100 000 of Stroke-Associated Hospitalization by Stroke Subtype

Stroke subtype	National Estimates (n)	Rate	95% Confidence Interval
Ischemic	3156	3.70	3.57-3.83
Hemorrhagic	2022	2.37	2.27-2.47

B. National Estimates and Rates per 100 000 of Stroke-Associated Hospitalization by Stroke Subtype and Age Group

	Hemorrhagic			Ischemic		
Age group	National Estimates (n)	Rate	95% Confidence Interval	National Estimates (n)	Rate	95% Confidence Interval
≤4 years	500	2.5	2.31-2.75	1168	5.9	5.57-6.24
5-9	294	1.5	1.32-1.66	471	2.4	2.17-2.60
10-14	411	1.9	1.75-2.13	466	2.2	2.00-2.40
15-20	818	3.3	3.10-3.55	1051	4.3	4.01-4.53

C. National Estimates of Stroke-Associated Hospitalization by Race/Ethnicity

	Hemorrhagic	Ischemic
Ethnic group	National Estimates (n)	National Estimates (n)
White	698	1142
Black	257	556
Hispanic	290	456
Asian/Pacific Islander	41	61
Native American	14	17
Other	110	134
Percent missing[b]	25.4%	25.0%

D. National Estimates and Rates per 100 000 of Stroke-Associated Hospitalization by Gender and Stroke Subtype

	Hemorrhagic			Ischemic		
Gender	National Estimates (n)	Rate	95% Confidence Interval	National Estimates (n)	Rate	95% Confidence Interval
Male	1089	2.49	2.34-2.64	1646	3.77	3.58-3.95
Female	906	2.18	2.03-2.32	1506	3.62	3.44-3.81

This table however only shows statistics for populations over 30 days old. It is important to note that the risk of stroke also peaks during the pre-natal period, the time period right before and immediately after birth (Kirton, et al., 2013).

Recognizing stroke in newborns and infants is often very difficult. Signs include seizures in one part of the body, often an arm or leg, difficulty eating, respiratory complications, and developmental delays (Gupta, 2016). Since development deficits such as problems with rolling over, crawling, walking and speech disorders emerge at different developmental stages; it is often difficult to recognize these issues, until the child reaches that time-period (Kirton et al., 2013). This poses a grave issue in the diagnosis and acute care of newborns whom have suffered a stroke and may not show any other immediate signs.

Warning signs in older children and young adults are similar to those adults experience; the typical slurring of speech, drooping of the face, weakness in the limbs, dizziness and blurred vision etc. (Jin, 2014). Other signs such as seizure, headache, vomiting, trouble swallowing, memory loss, and sudden behavioral changes can occur (Gupta, 2016)

Diagnosis of stroke in pediatrics is a pressing issue since the long term affects are extremely detrimental. According to the American Heart Association, 20-40% of children die from stroke, and of those who survive 20% have a recurring stroke and 50-80% are left with permanent neurological damage and poor quality of life. The life-long damages include short attention spans, visual disturbances, cognitive and sensory impairments, epilepsy, speech disorders and behavior issues (AHA, 2017). Pediatric stroke can lead to epilepsy and is the number one cause of hemiplegia and hemiparesis, partial or full paralysis on one side of the body, and the number one cause of cerebral palsy (AHA, 2017).

As one can see, the debilitating effects of pediatric stroke are extreme. It is enormously important for medical personnel to diagnose stroke as early as possible, and provide proper immediate and long-term care. If stroke is suspected, medical tests such as bloodwork, magnetic resonance imaging, magnetic resonance angiography, magnetic resonance venography, computed tomography scan, computed tomography angiography, cranial ultrasound, and spinal taps may be recommended depending on the age of the child and the presenting symptoms (Gupta, 2016). Other recommended tests can be seen in the table below (Tsze, 2011).

Table 2: Laboratory and diagnostic testing considerations for the acute pediatric stroke patient.

Additional laboratory tests to consider	Additional tests to consider
Liver function	Brain MRI
ESR	MRA
CRP	(i) Intracranial vessels
Pregnancy	(ii) Extracranial great vessels (neck)
ANA	MRV
Lupus anticoagulant	Diffusion weighted imaging (DWI)
Anticardiolipin antibody	CT angiogram
Beta-2 glycoprotein-1 antibody	(i) Intracranial vessels
Activated protein C resistance	(ii) Extracranial great vessels (neck)
Factor V Leiden mutation	Contrast transthoracic echo (TTE)
Protein S/C function	Cerebral angiogram
Antithrombin III	Contrast transesophageal echo (TEE)
Prothrombin gene mutation	Electroencephalogram (EEG)
Homocysteine level	Lumbar puncture
Methyltetrahydrofolate reductase allele (MTHFR)	Holter monitoring
Fibrinogen disorder	Transcranial doppler
Plasminogen activator inhibitor disorder	
Factor VII/VIII elevation	
Factor XII deficiency	
Plasma amino acids/urine amino and organic acids	
Serum and CSF lactate/pyruvate	
Hemoglobin electrophoresis	
Triglycerides/cholesterol	
Lipoprotein (a)	
Miscellaneous bacterial, fungal, spirochetal, parasitic, viral, and rickettsial tests (i.e., Lyme, PPD, VDRL)	
Serum and CSF varicella titers	
HIV titers	

Treatment for pediatric stroke has been adapted from treatment for adults and depends on the type of stroke experienced, however this proves to be complicated. Since most medications prescribed in treatment of adult stroke are only indicated for certain age groups, most do not include children in their indications. Low-dose aspirin and low-molecular weight anti-thrombotics (heparins; reviparin, enozaparin, tinzaparin), which are blood thinners that prevent the formation of blood clots, are a few medications that can be used in treatment and help prevent recurrence of ischemic stroke (Tsze, 2011). Thrombolytic therapy such as use of tissue plasminogen activator (tPA) is also used clinically to treat ischemic stroke because tPA assists in the breakdown of clots (Belvis, 2007). Treatment of hemorrhagic stroke can involve hydration, use of anticonvulsant drugs to control seizure, blood transfusions to treat underlying conditions such as sickle cell disease, and surgical intervention to control bleeding and relieve pressure on the brain (St. Louis Children's Hospital, 2015). There are also pediatric stroke hotlines, such as 1-800-NOCLOTS available for medical professionals to call to get immediate stroke management advice (Tsze, 2011).

Immediate diagnosis and treatment are crucial in pediatric stroke in order to minimize the long-term damage. Long-term treatment is also crucial, involving physical therapy and speech therapy (Gupta, 2016). There is a dire need for further research into immediate pediatric stroke treatment and long-term rehabilitation.

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PHARMACOLOGY

DEA LISTS SYNTHETIC OPIOID U-47700 AS A SCHEDULE 1 NARCOTIC: WHAT EMS PERSONNEL SHOULD KNOW

ANDREA COOPER

When rock god Prince died on April 21, 2016, the official cause of death was listed – and widely reported – as an accidental fentanyl overdose. In fact, though, according to the Midwest Medical Examiner's office, fentanyl was merely the major ingredient in a deadly chemical cocktail that killed the singer – a cocktail that included the synthetic opioid U-47700.

According to the US Centers for Disease Control and Prevention, death rates from synthetic opioids increased 72.2% from 2014 to 2015. (CDC) In recognition of the growing public health hazard posed by U-47700, in November 2016 the U.S. Drug Enforcement Administration (DEA) placed U-47700 into Schedule I of the Controlled Substances Act. The ban became effective on November 14th. (Furanyl fentanyl, a chemical relative of medically-prescribed fentanyl, has since been banned by the DEA as well.)

Emergency scheduling of drugs such as U-47700 on a temporary basis is a tool used by the DEA to block manufacturing and distribution – including online sales – of a substance pending further research. Until the scheduling went into effect, U-47700 could be easily purchased online as a "research drug." The temporary scheduling remains in force for 24 months, with a possible 12-month extension if the DEA needs more time to gather data on whether the drug should be permanently scheduled. Some states, including Ohio, Wyoming, Georgia, Wisconsin, Florida and Idaho, have also taken action to outlaw U-47700.

About U-447700

Sometimes referred to simply as U4, or as “pink” or “pinky” by Law Enforcement. U-47700 was created in a lab by the pharmaceutical company Upjohn, a leading pharma brand from 1886 until the mid-1990s. The synthetic substance was patented in 1978 as a less addictive, more potent alternative to natural opiates for the treatment of severe pain associated with cancer, surgery, or injury. Indeed, according to NMS Labs, an independent provider of forensic toxicology services, U-47700 has a potency of about 7.5 times that of morphine. ("NMS Labs Announces," 2016)

Natural opiates, including morphine, codeine, and thebaine, are alkaloid compounds found in the opium poppy plant Papaver somniferum. Opioids (a classification that includes natural opiates, derivatives, and synthetic drugs with opiate-like properties) are widely utilized for their pain relieving qualities. They work by attaching to specific proteins called opioid receptors located on nerve cells in the brain, spinal cord, gastrointestinal tract, and other bodily organs. When opioids attach to these receptors, they reduce the perception of pain and produce

a sense of wellbeing. Repeated use of opioids inhibits the body's production of the naturally occurring or endogenous opioids that support emotional health, which is why discontinued use (in other words, withdrawal) causes discomfort. (Volkow, 2014)

Although patented in the 1970s, U-47700 was never tested on humans and never progressed beyond "research" status. However, complete patent information, including included detailed instructions on how to produce the drug in a laboratory setting, remained publicly available online. By searching online patent records and old scientific journals, chemists in China have been able to reproduce a number of synthetic opiates such as U-447700. Until recently, as "research chemicals," these substances have largely escaped notice by law enforcement and the DEA. Complicating matters is the fact that manufacturers often adjust the chemical makeup of a drug just enough to avoid meeting the composition of the controlled substance. "Because substances like U-47700 are often manufactured in illicit labs overseas," notes DEA, "the identity, purity, and quantity are unknown, creating a 'Russian Roulette' scenario for any user." ("DEA Schedules Deadly Drug," 2016)

U-447700 first appeared on DEA's radar screen in October 2015. (Federal Register, 2016) That's when the first laboratory submission of U-47700 was recorded by the National Forensic Laboratory Information System (NFLIS). DEA utilizes NFLIS, a reporting system that collects drug chemistry analyses results conducted by participating Federal, State, and local forensic laboratories across the country, to monitor for drug trends. From October 2015 to September 2016, DEA received 88 reports from State and local forensic laboratories of U-47700 submissions. DEA received reports of at least 46 confirmed fatalities associated with U-47700, 31 in New York and 10 in North Carolina. NMS Labs confirmed more than 80 deaths nationwide in the first nine months of 2016.

Dealing with U-47700

U-47700 typically appears as a white or light pink chalky powder. Law enforcement agencies have encountered U-47700 in both powder and tablet form. The powder is typically distributed in glassine bags, envelopes, or in plastic bags with knotted corners, which suggests the drug is being marketed as a replacement for heroin or other opioids. In tablet form, U-47700 often appears as a counterfeit version of pharmaceutical opioids such as oxycodone. (WHO) It also appears in liquid form — usually in dropper bottles or empty nasal inhalers. (Neogen, 2016). U-47700 has been encountered in stand-alone form and in combination with other opioids such as heroin, fentanyl, and furanyl fentanylin. These marketing techniques suggest that in many cases, users may not know they are taking U-47700.

As EMS personnel know, naloxon is often considered the "magic bullet" for treating overdoses of heroin and other opiates. Naloxone is a quick-acting opioid antagonist that competitively binds to opioid receptors, reversing the effects of opioids in the central nervous system and gastrointestinal tract.

Naloxone was first approved in the USA in 1971. In addition to pre-filled syringes and vials, in November 2015 the FDA approved Narcan Nasal Spray as the first the non-injectable naloxone product for the treatment of opioid overdose.

The typical dose of naloxone is 0.4–2.0 mg for adults and children. However, there is some evidence that extremely potent synthetic opioids – such as fenalyn, U-47700, and an even newer substance known as W18 – all of which may be substituted for other opioids or added to them without the user's knowledge – may require higher dosage and additional support. An EMS industry source recommends that patients receive "a titrated dose of naloxone starting at 0.4 mg and administered in 0.4-mg increments until respiratory depression is corrected."

On the frontlines

EMS personnel are already at the forefront of caring for synthetic opioid overdoses by providing first-responder care such as ventilatory support and naloxone. EMS-reported data can also help local, state and national health organizations identify and track emerging trends in opioid use across America. The DEA scheduling of U-47700 is an example of how data gleaned from the field can shape US policy and hopefully prevent overdose deaths.

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PHARMACOLOGY

CARFENTANIL OVERDOSE: RISKS AND RECOMMENDATIONS

BRANDI TALKINGTON, PH.D

Fentanyl, a fast-acting opioid 50-100 times more potent than morphine, was first introduced into the United States (US) in 1968 as an intravenous anesthetic (Stanley, 2014; Suzuki & El-Haddad, 2017). Completely synthetic, fentanyl's analgesic effect can occur as soon as 1 to 2 minutes after intravenous administration (Stanley, 2014). Significant analgesia can occur with fentanyl plasma concentrations as low as 0.2 to 1.2 ng/mL in opioid-naïve individuals and last approximately 2 to 4 hours (Stanley, 2014).

Fentanyl is rapidly taken up into tissues with a subsequent slow re-distribution back into plasma, causing prolonged elimination and respiratory depressant effects (Suzuki & El-Haddad, 2017). Superior clinical success and cheaper production fueled the popularity of fentanyl for medical use and the creation of analogues for additional benefits (Suzuki & El-Haddad, 2017).

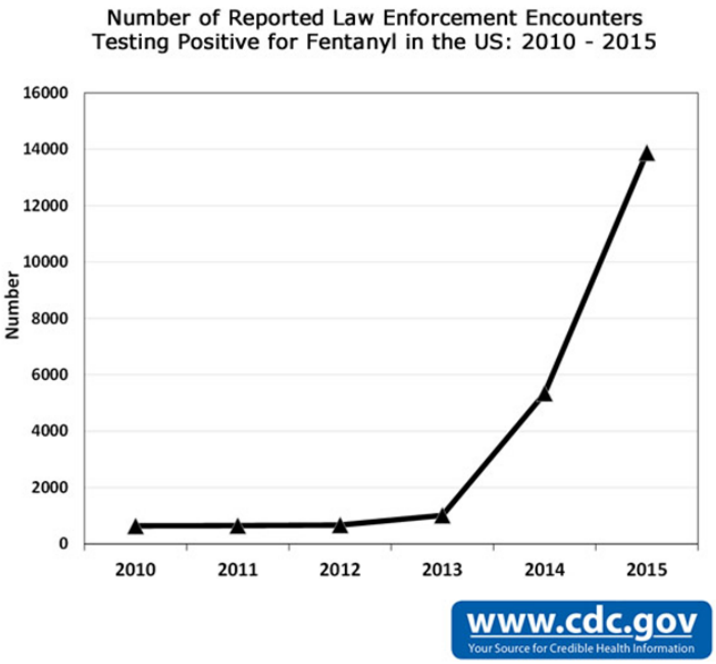
Carfentanil (carfentanyl/Wildnil), a fentanyl analogue with a clinical potency 10,000 times that of morphine and 100 times that of fentanyl, was created for veterinary use in large animals and is considered a Schedule II controlled substance by the US Drug Enforcement Administration (NIOSH, 2016; Suzuki & El-Haddad, 2017).

Carfentanil is classified and has been used in the past as a chemical weapon and can be lethal in the 2 mg range (Anderson, 2012; DEA, 2016). Fentanyl, and more recently, carfentanil, has surfaced in the streets of US communities as a component of various recreational drugs, posing a serious danger to public safety (DEA, 2016).

Illicitly manufactured carfentanil is often found in powder form for inhalation or injection; can be pressed into counterfeit tablets to be sold as commonly misused prescription opioids, such as Oxycodone, Xanax, and Norco; and has been found in samples of heroin, cocaine, and methamphetamine (CDC, 2016b; NIOSH, 2016).

While some dealers have taken advantage of the potency of fentanyl and its analogues (one gram of pure fentanyl can be cut into approximately 7000 street doses) by adding small amounts of drug to mixtures consisting mostly of fillers, users have begun actively seeking carfentanil because of its long-acting sedative affects (Suzuki & El-Haddad, 2017).

The recent eruption of heroin laced with carfentanil to increase its potency and carfentanil use alone presents a unique and potentially dangerous situation for emergency personnel responding to overdose situations (Figure 1) (Suzuki & El -Haddad, 2017).



Centers for Disease Control and Prevention, retrieved from https://www.cdc.gov/drugoverdose/data/fentanyl-le-reports.html on February 4, 2017.

Risks to emergency responders

The Centers for Disease Control and Prevention National Institute for Occupational Safety and Health (CDC NIOSH) cautions emergency responders on unintentional contact with carfentanil, with exposure routes varying on the source of the drug (NIOSH, 2016). Inhalation of powder is the most likely exposure route when dealing with illicitly-manufactured carfentanil, resulting in rapid respiratory depression (NIOSH, 2016). There are currently no established occupational exposure limits for carfentanil, although pharmaceutical industry internal standards place the limit at 0.00032 mg/m3 (NIOSH, 2016).

Dermal exposure to carfentanil can result in absorption over hours to days (CDC, 2016a). As illegal carfentanil is typically found in powder form for injection, first responders should be mindful of unintentional powder exposure or needle sticks when responding to an overdose situation (NIOSH, 2016).

Recommendations for emergency responders

NIOSH recommends the use of powder-free nitrile gloves when dealing with potential carfentanil exposure (NIOSH, 2016). In comparison to latex, nitrile gloves generally show low permeability to hazardous drug compounds (NIOSH, 2016). Additionally, powder particulates in powdered gloves may absorb narcotic compounds, increasing the potential for dermal contact or spread of contaminants to unintended surfaces (NIOSH, 2016). If a first responder will be performing any task that would potentially aerosolize carfentanil, NIOSH recommends dermal protection on both arms and legs (NIOSH, 2016).

When handling carfentanil, CDC NIOSH recommends using a NIOSH-approved half-mask filtering facepiece respirator rated P100 or a tight-fitting full facepiece air-purifying respirator with multi-purpose P100 cartridges/canisters (NIOSH, 2016). Alternatively, NIOSH suggests a NIOSH-approved elastomeric half mask air-purifying respirator with multi-purpose P100 cartridges with ocular protection (NIOSH, 2016).

A recent study suggested that increased public knowledge of fentanyl, fentanyl analogues, and their incorporation into illicit drugs can lead to increased accuracy in emergency 911 calls, allowing better dispatch of equipment and staff and resulting in more lives saved from overdose (Faul et al., 2015). Using local surveillance data of overdose rates and naloxone use can help to determine future needs for naloxone supply (Faul, et al., 2015).

First responders should be aware of common street names for fentanyl and fentanyl analogues, including “China White”, “Apache”, “China Girl”, “Dance Fever”, “Friend”, “Goodfella”, “Jackpot”, “Murder 8”, “TNT”, “Tango and Cash”, “Synthetic Heroin”, “Drop Dead”, “Lethal Injection”, and “Get High or Die Trying” (Suzuki & El-Haddad, 2017).

Treating carfentanil overdose

Carfentanil exposure results in respiratory depression that can occur within minutes of exposure (DEA, 2016). Immediate administration of naloxone, with continuous naloxone administration every 2-3 minutes until the individual is breathing on their own for at least 15 minutes, is required (DEA, 2016).

Due to its increased potency and unknown quantity in illicit products, multiple doses of naloxone may need to be administered in cases of carfentanil overdose (CDC, 2016b). Orally-ingested counterfeit pills laced with carfentanil may require prolonged naloxone dosing due to delayed toxicity (CDC, 2016b). The CDC recommends increasing the amount of naloxone on hand with emergency personnel due to the increased amount needed and rate of use during an overdose outbreak (CDC, 2015).

To help ease the burden of this unprecedented need for multiple naloxone administrations, the Food and Drug Administration Anesthetic and Analgesic Drug Products Advisory Committee and the Drug Safety and Risk Management Advisory Committee voted to recommend increasing the amount of naloxone in new injectable and intravenous naloxone products for use outside of a hospital or medical setting (FDA, 2016; Valentino, 2016). This idea will be further explored by the Food and Drug Administration Center for Drug Evaluation and Research; future effects for first responders will remain to be seen (FDA, 2016; Valentino, 2016).

Necessarily increased doses of naloxone when responding to carfentanil overdose increase the likelihood of acute opioid withdrawal syndrome. Naloxone antagonizes opioid effects by competing for the same receptor binding sites (ADAPT, 2015). The immediate effects of naloxone may precipitate severe opioid withdrawal (ADAPT, 2015). Emergency responders should be prepared for the common effects of severe opioid withdrawal, which include body aches, diarrhea, tachycardia, fever, runny nose, sneezing, piloerection, sweating, yawning, nausea and vomiting, nervousness, increased blood pressure, restlessness and irritability, trembling, abdominal cramps, and weakness (ADAPT, 2015). Emergency responders should also be aware of and prepared for potentially combative, unpredictable, and violent outbreaks from users going through severe opioid withdrawal (NIOSH, 2016).

The recent sharp increase in carfentanil abuse presents a unique crisis and unusual hazard for first responders (DEA, 2016). As carfentanil can be lethal even in extremely small doses, extreme caution must be taken when handling potential carfentanil or responding to cases of carfentanil overdose (DEA, 2016). First responders should be aware of the potential hazards and take active measures to reduce unintentional exposure (DEA, 2016). First responders should also be aware that incorporation of carfentanil into counterfeit pills for broad distribution across the US could cause an increase in carfentanil abuse in states that have not been previously impacted (CDC, 2016b). The widened use of carfentanil in heroin and other illicit products with an increasing supply and distribution will continue to plague US communities in the immediate future (CDC, 2016b).

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PEDIATRICS

NEONATAL ABSTINENCE SYNDROME: PROTECTING THE MOST VULNERABLE VICTIMS OF DRUG ABUSE

BRANDI TALKINGTON, PH.D

Neonatal exposure to and withdrawal from illicit drugs and alcohol is not a new phenomenon, with the first case of documented neonatal opioid withdrawal dating to 1875 (Kocherlakota, 2014). However, the current opioid and heroin crisis barreling across the United States is causing an alarming increase in incidence rates of neonatal abstinence syndrome (NAS), the abrupt discontinuation of chronic substances to a neonate that were used or abused by the mother during pregnancy (Ko et al., 2016; Kocherlakota, 2014). Characterized by central nervous system irritability, autonomic overreactivity, and gastrointestinal tract dysfunction that manifest shortly after birth, the incidence of NAS in the United States increased by 383% between 2000 and 2012 (Hudak & Tan, 2012; Ko, et al., 2016).

Symptoms of NAS

The clinical presentation of NAS varies based upon the drug used, maternal drug history, maternal metabolism, net transfer of drug across the placenta, placental metabolism, and infant metabolism and excretion (Hudak & Tan, 2012). Neonatal withdrawal from heroin typically begins within 24 hours, while withdrawal from methadone begins up to 72 hours after birth (Hudak & Tan, 2012). Different time courses of onset reflect different drug half-lives (Hudak & Tan, 2012). Although NAS is rarely fatal, it can cause significant illness and prolonged hospital stays (Kocherlakota, 2014).

Common signs and symptoms at the onset of NAS include jitteriness, diarrhea, tremors, and excessive, inconsolable crying marked by a striking, high-pitched cry (Kocherlakota, 2014). Seizures can occur, requiring immediate treatment, and hyperirritability can lead to agitation and difficulty sleeping (Kocherlakota, 2014). Symptoms characteristic of methadone withdrawal include tremors, exaggerated Moro reflex, hypertonia, and myoclonic jerks, while a chemical odor is common in neonates born to mothers who abuse inhalants (Kocherlakota, 2014). Autonomic nervous system signs, including temperature instability, sweating, sneezing, and mottling, may persist for months or longer, particularly in cases of maternal buprenorphine use (Kocherlakota, 2014).

The onset, duration, and frequency of NAS caused by various substances is summarized in Table 1.

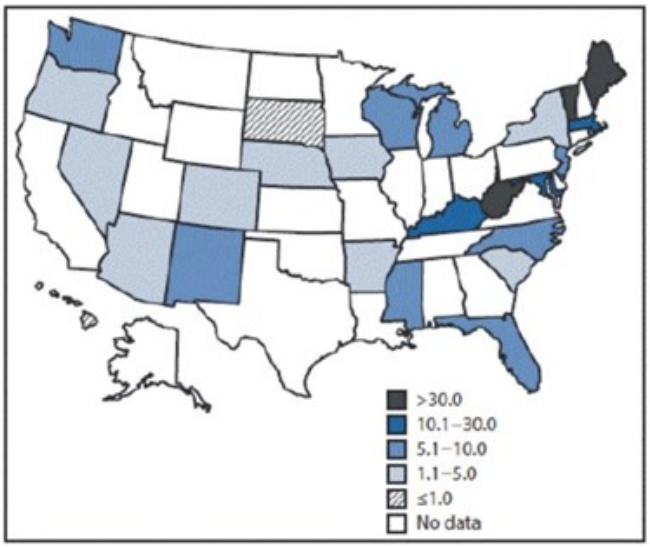
Drug	Onset, h	Frequency, %	Duration, d
Opioids			
Heroin	24-48	48-80	8-10
Methadone	48-72	13-94	Up to 30 or more
Buprenorphine	36-60	22-67	Up to 28 or more
Prescription opioid medications	36-72	5-20	10-30
Nonopioids			
SSRIs	24-48	20-30	2-6
TCAs	24-48	20-50	2-6
Methamphetamines	24	2-49	7-10
Inhalants	24-48	48	2-7

SSRI, selective serotonin reuptake inhibitor; TCA, tricyclic antidepressant.

Prevalence of NAS

Although misuse of various substances can lead to NAS, it is most often attributed to in utero opioid exposure (Ko, et al., 2016). The latest survey results from the Substance Abuse and Mental Health Services Administration National Survey on Drug Use and Health reported that 3.8 million American people age 12 and older documented misuse of prescription pain relievers in 2015 (SAMHSA, 2015). Heroin use was documented in approximately 329,000 individuals, although heroin use has increased steadily since this time (DEA, 2016; SAMHSA, 2015). Total incidence rates of NAS vary by state, with an overall incidence of 2.5 cases per 1,000 hospital births (Ko, et al., 2016). States with the lowest incidence of NAS in 2013 were Hawaii, South Dakota, and Nebraska, with 0.7, 0.9, and 1.6 cases of NAS per 1,000 hospital births, respectively (Figure 1) (Ko, et al., 2016). States with the highest rates of NAS in 2013 were West Virginia, Vermont, and Kentucky, with 33.4, 33.3, and 15.0 cases of NAS per 1,000 hospital births, respectively, although 2012 data for Maine reports an incidence of 30.4 cases of NAS per 1,000 hospital births (2013 data not available)(Figure 1) (Ko, et al., 2016). In addition to disparities in increased NAS prevalence by state, the incidence of NAS and maternal opioid use has also increased disproportionately in rural counties relative to urban counties (Villapiano, 2017). An estimated 80% of the $1.5 billion in NAS-related hospital charges in 2012 were covered by state Medicaid programs (Ko, et al., 2016).

Figure 1: Neonatal abstinence syndrome (NAS) incidence rates* – 25 states, 2012-2013†



*NAS cases reported per 1,000 hospital births, †Incidence rates reported are for 2013, except for Maine, Maryland, Massachusetts, and Rhode Island, for which 2013 data were not available; 2012 data are reported for these states.

Treatment During Pregnancy and Prevention of NAS

Pregnant women with an opioid abuse disorder have a higher frequency of risk factors for adverse pregnancy outcomes, such as chronic viral infections, psychiatric conditions, poor health behaviors, adverse social conditions, and inadequate prenatal care, than pregnant women who do not use opioids (Zedler et al., 2016). The World Health Organization and American College of Obstetricians and Gynecologists recommend that pregnant women dependent on opioids be encouraged to use opioid maintenance therapy, such as methadone or buprenorphine, whenever available rather than attempt opioid detoxification (ACOG, 2012; WHO, 2014). Women who wish to undergo detoxification are recommended to do so in an inpatient or hospital facility to increase the chance of successful completion and allow fetal heart and movement monitoring during the withdrawal process (WHO, 2014). Monitoring for signs of fetal distress can allow the withdrawal process to be slowed or halted (WHO, 2014). While some studies suggest that there is no harm to either mother or fetus during detoxification of opiate-addicted pregnant women who receive long-term behavioral therapy, others suggest that relapse to opioid use is more likely following medication-assisted withdrawal than while undergoing opioid maintenance treatment (Bell et al., 2016; Zedler, et al., 2016).

Adequate medical treatment that maintains stable opioid blood levels and reduces maternal craving for and use of heroin or other opioids improves prenatal care and fetal/infant outcomes compared to untreated opioid use or opioid withdrawal (Zedler, et al., 2016). Methadone and buprenorphine are common, long-acting opioid agonists used for medication-assisted treatment (Zedler, et al., 2016). Both are effective and provide improved safety compared with continued opioid use during pregnancy, although buprenorphine has been associated with lower risk of preterm birth, greater birth weight, and larger head circumference (Noormohammadi et al., 2016; Zedler, et al., 2016). Opioid maintenance treatment-exposed neonates may also require less morphine to treat symptoms, shorter hospital stays, and shorter durations of medical treatment (Yonkers, 2016).

Challenges to preventing NAS include the fact that 86% of pregnancies in women who abuse opioids are unintended, and women using opioids may not initially know that they are pregnant (Barfield, 2016). Early screening can lead to higher rates of detection and identification of women who need assistance for prescription opioid and substance abuse during pregnancy (Yonkers, 2016). A survey of women's attitudes towards legal requirements for prenatal drug testing determined that 86% of respondents would support a law requiring verbal drug screening of pregnant patients, and 73% would support universal urine drug testing; however, 14% indicated that mandatory drug testing would discourage them from seeking prenatal care (Tucker Edmonds, et al. 2016). While targeted screening and testing for prenatal drug use is fairly supported by women of reproductive age, drug testing policies may also have detrimental effects on maternal and child health (Tucker Edmonds, et al. 2016).

In 2003, the United States government amended the Child Abuse Prevention and Treatment Act to the Keeping Children and Families Safe Act of 2003. This amendment requires health care providers involved in the delivery or care of infants affected by illegal substance abuse or withdrawal symptoms resulting from prenatal drug exposure to notify child protective services (Congress, 2003). Although most infants will recover completely, the home environments to which they are discharged are often plagued by serious drug addiction and can pose a danger to a child's health and life (Dyer, 2016). An investigation into the underreporting of NAS identified that many providers were reluctant to report a mother who was receiving treatment and

trying to get better or who would face imprisonment if testing positive for drugs (Dyer, 2016). The Protecting Our Infants Act of 2015 tasks the Department of Health and Human Services with developing recommendations for preventing and treating prenatal opioid abuse and NAS, while the Comprehensive Addiction and Recovery Act of 2016 hopes to provide a broad approach to prevention of addiction and expansion of treatment for all people, including pregnant women and children (Congress, 2015, 2016).

Opioid use affects both mother and child throughout the full course of life, from the pre-pregnancy stage to childhood and beyond (Patrick, 2016). Consistent and comprehensive approaches to mitigate outcomes for affected infants, mothers, and the health care system are necessary to produce positive effects (McQueen & Murphy-Oikonen, 2016). Primary methods of NAS prevention possibly include increased access to effective contraception, particularly long-acting reversible contraception such as intrauterine devices and contraceptive implants, and responsible opioid prescribing (Broussard, 2016; Patrick, 2016). Secondary preventative methods may include screenings, brief interventions, and referrals to treatment, while tertiary methods include decreasing variability in treatment and preventing readmissions (Patrick, 2016). Harm reduction will most likely come from a multidisciplinary approach, with resources and support from obstetric, pediatric, primary care, addiction medicine, mental health care, and social work (Sutter, et al. 2017). This support will hopefully provide significant benefits to form the basis of improved health and social well-being for future generations (Sutter, et al., 2017).

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PEDIATRICS/PSYCHOLOGY

PEDIATRIC PSYCHIATRIC CARE: CURRENT STATUS AND RECOMMENDATIONS

DR. JESSICA DIAZ-NAGEL

Introduction

One in every ten children and adolescents in the United States endure psychiatric conditions which produce impairment, huge inconvenience, and can negatively affect productivity in adulthood (The National Advisory Mental Health Council Workgroup on Child and Adolescent Mental Health Intervention Development and Deployment, 2001). The Surgeon General's report on mental health revealed that 21% of children in the US ages 9 to 17 years have a mental or addictive disorder (US Department of Health and Human Services, 1999).

Half of psychiatric problems start before the age of 14, and three quarters before the age of 24 (Child Mind Institute, 2017). The report from the said institute stated that the impact of these disorders may be worse than in adults because they affect children at a crucial stage of social and emotional development

An investigation by Kataoka, Zhang, and Wells (2002) indicated that merely 21% of US children who have required a mental health assessment have received it. The authors estimated that this need has gone unmet for 7.5 million children.

Emergency department healthcare providers are often called upon to care for patients with known or undiagnosed psychiatric issues (Dolan, Fein, & The Committee on Pediatric Emergency Medicine, 2011). The same authors acknowledged that emergency departments might be disrupted in their routines by patients who need psychiatric care as they could necessitate more resources than patients with other diagnoses.

Pediatric Psychiatric Emergency Visits in the US

Sills and Bland (2002), who studied statistics from 1993 to 1999, found increased visits to the emergency departments for mental health problems for children under 19 years of age, especially for females, nonwhites, adolescents, and with residence in the Northeast or Midwest. They attributed part of the increase to less urgent issues, which could have been presumably dealt with at outpatient settings. The authors concluded it could have been due to a shortage of mental health providers for this population. The investigators also observed that emergency departments frequently lacked adequate staffing for dealing with pediatric psychiatric issues.

According to Pittsenbarger and Mannix (2014), emergency departments in the US received 491,000 children under 18 with psychiatric issues in 2001, and 619,000 in 2010. Factors found to be related to an increased frequency of emergency visits included being a child with public insurance and being 13 years and older.

The authors mentioned that the escalation of visits may have been due to various reasons, one of them could have been diminished access to outpatient services.

Simon and Shoendorf (2014) examined records of pediatric psychiatric visits to emergency departments among children and adolescents 6 to 20 years of age. They reported that the percentage of visits for mental health issues was 4.4% of all emergency visits in 2001 and 7.2% in 2011. According to their study, this represented an increase of 0.19 percentage points and reached statistical significance. The authors noted that white children had lower visit frequencies than black children; rates were also lower for 6 to 12-year-olds than for youths 13 to 20 years of age.

Rogers, Mulvey, Divietro, and Strum (2017), who analyzed data for children under 18 years from 2009 to 2013, observed that the national rates of emergency pediatric mental health concern visits increased from 9.3 visits per 1000 in 2009 to 13.7 visits per 1000 in 2013. They noted that this represented an increase of more than 40%.

According to S. Case, B. Case, Olfson, Linakis, and Laska (2011), who studied information from The National Hospital Ambulatory Medical Care Survey, pediatric emergency mental health visits are longer, more often referred for urgent evaluation, and more prone to end up as an admission, compared to other pediatric emergencies. They indicated this has caused significant strain on emergency services in the US.

The American College of Emergency Physicians (2016) concluded that urgent situations in pediatric mental health have represented a hefty part of pediatric emergencies. They emphasized that it has been a consequence of insufficient outpatient services in the pediatric mental health infrastructure. Pediatric primary care providers might not be adequately trained to care for children with psychiatric issues (Burka, Van Cleve, Shaefer, & Barkin, 2014). Healthcare providers in emergency services must therefore manage pediatric patients with different kinds of mental problems (American College of Emergency Physicians, 2016).

Interventions and Recommendations for Improving Pediatric Mental Health Care

The following interventions and recommendations are a few proposed/available approaches intended to address the challenges in pediatric psychiatric care.

The American College of Emergency Physicians (2016) has made some recommendations on this issue. They emphasized that it was necessary to:

a. Support the availability of suitable psychiatric services for children who are hospitalized and for those in the community.

b. Improve means for emergency departments to help children who are victims of violence, trauma, disasters, and suicide attempts.

c. Ensure that mental health services are adequately reimbursed.

d. Encourage the continuity of the child's medical home.

e. Promote inclusive pediatric psychiatric insurance coverage.

f. Be in favor of research funding for pediatric psychiatric problems.

g. Support education and investigation for pediatric psychiatric emergencies.

The Child Mind Institute (2017) in its 2016 report, advocated for prevention and involvement efforts in schools. They outlined several interventions, according to age, which they alleged could prevent and mitigate mental health issues in children and adolescents.

In Canada, Latimer, Gariépy, and Greenfield (2014), studied the cost-effectiveness of a rapid-response team intervention for suicidal adolescents presenting in the emergency department of a pediatric hospital in Quebec. The team included a psychiatrist, a psychiatric nurse, and other healthcare providers like a social worker, an educational specialist, or an art therapist. They reported that the rapid-response team intervention was more cost-effective than usual care, from the standpoint of the medical facility.

An important intervention is the education of primary care providers on mental health screening, assessment, diagnosis, and treatment (Burka et al., 2014). In line with this idea, the aforementioned authors designed a 2-day workshop for primary care providers in Pennsylvania, on mental health care for children and adolescents. They found that the participants significantly boosted their knowledge level after the workshop. One month after the workshop, the primary care providers reported an escalation in the amount of comfort and a change in practice (Burka et al., 2014).

Another possible intervention in primary care was offered in a report written by Foy, Kelleher, Laraque, for the American Academy of Pediatrics Task Force on Mental Health (2010). They proposed strategies for preparing primary care practices for pediatric mental health care, based on the chronic care model.

Sarvet et al. (2010), gathered information from July 2005 to December 2008 from The Massachusetts Child Psychiatry Access Project, a publicly funded program which has helped pediatric primary care providers with the management of psychiatric issues. Their study showed that a high percentage of pediatric primary care providers in Massachusetts enrolled in the program and were satisfied with it. The authors posited that a large number of pediatric patients with psychiatric problems were seen by these primary care providers and did not necessitate referral to the few existing child psychiatrists, thus making these specialists available for patients with more severe pediatric psychiatric disorders.

Conclusions

Mental health issues may affect children adversely (Child Mind Institute, 2017; The National Advisory Mental Health Council Workgroup on Child and Adolescent Mental Health Intervention Development and Deployment, 2001). Outpatient pediatric psychiatric services may be insufficient for the real need (American College of Emergency Physicians, 2016), and pediatric psychiatric emergency visits have been increasing (Pittsenbarger & Mannix, 2014; Rogers et al., 2017; Sills & Bland, 2002; Simon & Shoendorf, 2014). To handle these challenges, Dolan et al. (2011) have indicated that: 1. It is necessary to strengthen the pediatric outpatient mental health services by using community resources and supporting and educating primary care providers; and, 2. To better deal with pediatric psychiatric emergencies, it is important to implement an approach that tackles the problem in three areas: education, research, and advocacy.

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PSYCHOLOGY

DE-ESCALATION OF PSYCHIATRIC EMERGENCIES

DR. JESSICA DIAZ-NAGEL

Introduction

De-escalation of possibly hostile events is not new; it has existed in the past in the form of mediation and dispute resolution (Cowin, 2003). When confronted with agitated patients, noncoercive tactics can have successful outcomes (Richmond et al., 2012). De-escalation procedures can even be customized to be used with hearing-impaired restless patients (Jeffery & Austen, 2005). The objective of these techniques is to halt the intensification of hostility and to achieve the patient's collaboration for medical care (Knox & Holloman, 2012). De-escalation tactics are effective, but they require the provider to have adequate communication and interpersonal skills (Irwin, 2006). According to an expert consensus (Garriga et al., 2016), verbal de-escalation should be one of the first strategies used in the management of mild-to-moderate agitated patients, in an effort to avoid physical restraining. It may not be possible to completely eliminate restraint and confinement in psychiatric services, but these strategies can aid in reducing it (Knox & Holloman, 2012).

De-escalation of agitated patients in the emergency setting

Staff working with agitated patients must learn to quickly create rapport, evaluate the degree of danger, and help the patient with adequate coping skills (Roberts & Ottens, 2005).

Healthcare providers should bear in mind four important goals when approaching an unsettled patient: 1.- Make sure everyone in the area is safe, 2.- Assist the patient in the process of keeping his behavior under control, 3.- If feasible, do not use restraints, 4.- Steer clear of forced procedures that may worsen agitation (Richmond et al., 2012).

Bowers (2014) proposes a de-escalation model as follows:

1. Delimit: Ensure safety for everyone in the area. Keep a suitable distance from the agitated patient.
2. Clarify: Ask the patient why he/she is upset. Offer assistance and maintain the patient oriented (for example, by reminding them where they are, who you are, etc.).
3. Resolve: Attempt to uncover some form of dealing with whatever is distressing the patient that will suit him/her. This may be done by suggesting various courses of action, being flexible, and carefully listening to the patient.

While the healthcare worker is proceeding with the aforementioned steps, Bowers (2014) deems two issues important:

The healthcare provider must control him/herself: Even though he/she may be feeling

frustration and anxiety, this should not be conveyed to the patient. The best way to react to insults from the patient is not to take it personally and show a flat emotional expression.

The healthcare provider must show respect and empathy: Demonstrating concern, respect, and understanding is part of making the de-escalating process successful.

Guidelines for de-escalating agitated patients

Richmond et al. (2012), recommend the following guidelines:

- Physical space should be safe: This may include movable furniture, suitable exits, and avoiding harsh sensory stimulation. Objects that can be used as weapons must be taken away or safeguarded.
- Make sure the staff is competent for dealing with agitated patients: Working with agitated patients can be taxing. Healthcare providers in this field must understand their own limits and be aware of their negative reactions.
- Healthcare providers must receive proper training: The American Psychiatric Association Task Force on Psychiatric Emergency Services (Allen et al., 2002) has recommended that healthcare providers that deal with psychiatric emergencies receive training in managing agitation in the least restrictive manner at least once a year. De-escalation techniques can also be practiced in daily work with patients even if not agitated.
- There must be a suitable number of trained providers available: In an emergency room, there should ideally be about 4 to 6 team members available to work with an agitated patient.
- Rating scales can be used to evaluate agitation: One scale that is easy to use is the Behavioral Activity Rating Scale (BARS) (Swift, Harrigan, Cappelleri, Kramer, & Chandler, 2002, as cited in Richmond et al., 2012, p. 20) (Table 1). If the score is higher than 4 the patient must be assessed. Recognizing the level of agitation helps to know which intervention is optimal, and de-escalation can develop correspondingly (Lofchy, Boyles, & Delwo, 2015).

Behavioral Activity Rating Scale (BARS). (Swift, Harrigan, Cappelleri, Kramer, & Chandler, 2002, as cited in Richmond et al., 2012, p. 20)

1. Difficult or unable to rouse
2. Asleep but responds normally to verbal or physical contact
3. Drowsy, appears sedated
4. Quiet and awake (normal level of activity)
5. Signs of overt (physical or verbal) activity, calms down with instructions
6. Extremely or continuously active, not requiring restraint
7. Violent, requires restraint

De-escalation tactics

Fishkind (2002) proposes ten strategies for de-escalation:

A. Ensure enough personal space: A good distance to keep from the patient is two arm's length, more if the patient is paranoid.

B. Don't be provocative: Be calm and use a relaxed posture. Do not threaten the patient, as this may terminate the therapeutic alliance.

C. Establish verbal contact: There should be only one healthcare provider interacting verbally with the patient, ideally the first provider to make contact with him/her. If the provider is unable to take on the job, another person should be designated as quickly as possible.

Be polite, provide orientation and reassurance.

D. Be concise and repeat yourself: To avoid confusion, use simple words and sentences. Agitated patients will probably not hear the healthcare provider the first time; it may be necessary to repeat statements several times.

E. Identify wants and feelings: This will greatly help in building a therapeutic alliance.

F. Listen: The healthcare provider must make sure he/she understands what the patient is saying. Arguing with the patient is not recommended.

G. Agree or agree to disagree: The clinician should try to agree with the patient as much as is feasible. If it is not possible to agree, then agree to disagree.

H. Lay down the law: Set limits and be sure the patient understands there are consequences to his/her actions.

I. Offer choices: Offering a choice such as a time-out can be a good strategy for a patient that feels there are no choices left but to act a certain way.

J. Debrief patient and staff: If forceful intervention was necessary, the clinician who ordered the restraint/medication should debrief the patient after he/she is calm. It is also important to debrief the staff on these procedures and welcome any observations from them.

Conclusions

It is important to manage agitation adequately. Current guidelines recommend the use of verbal de-escalation techniques as a first-line approach to agitated patients (Garriga et al., 2016; Richmond et al., 2012; Knox & Holloman, 2012). Verbal de-escalation procedures can be used in the emergency setting to decrease hostility. These tactics can help the patient stay in control and build a good therapeutic alliance with the healthcare provider (Richmond et al., 2012).

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MEDICAL

THE PRESENTATION OF NON-COMMUNICABLE DISEASES IN YOUNGER POPULATIONS LINKED TO A SEDENTARY LIFESTYLE

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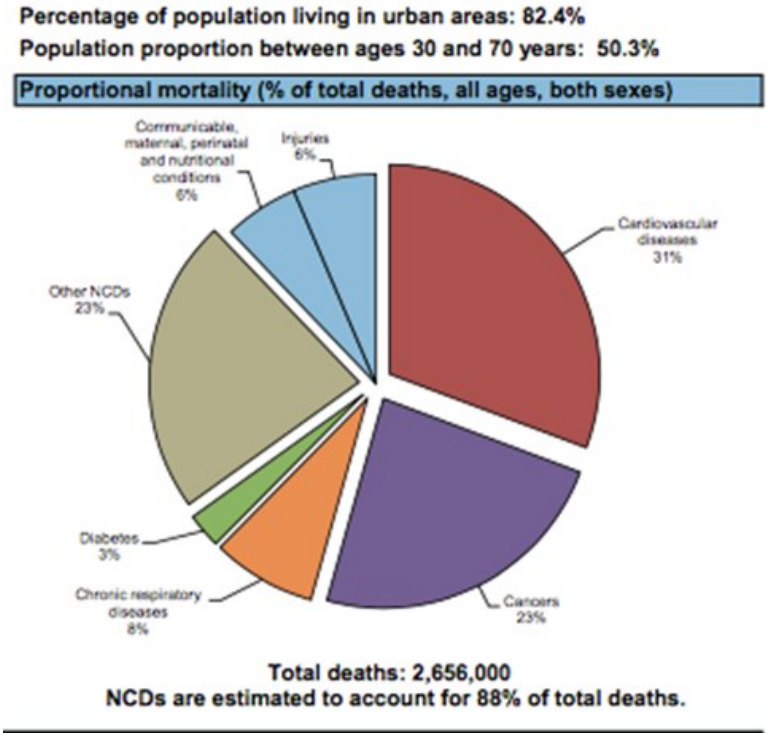
According to the World Health Organization (WHO) conditions such as cardiovascular disease, diabetes, respiratory disease and cancer are all caused by the same risk factors and are more commonly identified as non-communicable diseases (NCDs) (2015). These conditions are proven to be linked to sedentary lifestyles and other accompanying risk factors such as tobacco use, alcohol abuse and poor nutrition (Hunter, 2013). The rise of NCDs is a global health epidemic, claiming over 30 million lives each year and affecting younger populations around the globe (WHO, 2015).

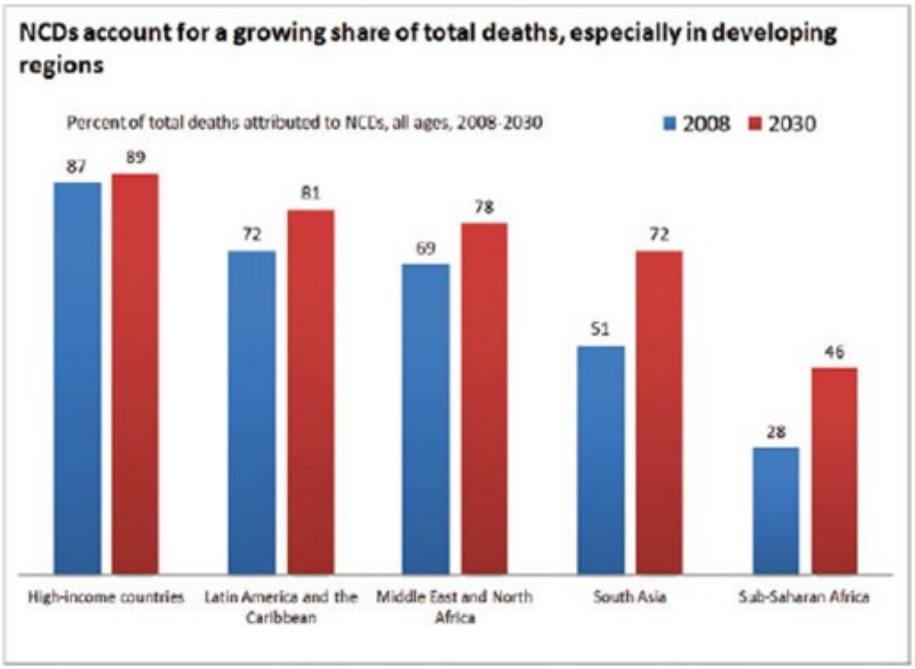
One of the major risk factors contributing to these diseases is physical inactivity. This risk factor alone increases the risk of mortality by 20-30% (WHO, 2011). Coupled with the other major risk factors, one creates a perfect storm for the onset of NCDs. Since these risk factors are often habits taken on at early ages, the prevalence in younger populations is increasing dramatically. According to the World Health Organization, 23% of adults over the age of 18 are not sufficiently active, and an alarming 81% of adolescents aged 11-17 are insufficiently active (2017). Shifts in socio-economic conditions throughout the world are leading to these high rates of inactivity.

High-income countries have certainly seen the shifts in the socio-economic landscape over the past century, changing people's lifestyles' dramatically. They've shifted away from the vast majority of jobs requiring manual labor, to jobs that require little to no physical activity at all. People are spending more time in front of a screen, whether it be the TV, computer, cell phone etc. than they ever have in the past. Rather than biking or walking as a source of transportation, people are frequently sitting in cars, on buses, trains, planes etc. and for extended periods of time. Despite the convenience of these advances, they are having a detrimental effect on the amount of daily physical activity being performed. These populations have the easy access and money to spend on alcohol, cigarettes and/or other social activities. Fast paced life-styles are inhibiting people from taking the time to prepare nutritious meals, and having a desk job makes sitting around all day more common. This has created a situation in which 41% of men and 48% of women in high-income countries are not sufficiently physically active (WHO, 2017). This is almost half of the entire population of high-income countries. Because the majority of high-income countries' populations (82.4%) live in urban areas, they are most affected by the socio-economic influences that lead to NCDs and are seeing an extremely high percent of deaths. Take for example statistics on the mortality rates from the United States published in the World Health Organization's Non-Communicable

Diseases Country Profiles Report, 2014 (seen in the pie chart below).



As you can see, NCDs attribute to 88% of the total deaths in the United States. Other high-income countries have similar statistics. However, although it may seem like high-income countries are most affected, currently, 80% of deaths linked to NCDs actually occur in low and middle-income countries (Hunter, 2013), and are affecting younger populations. NCDs account for 29% of deaths in people under the age of 60 in lower income countries as opposed to 13% of deaths in people under the age of 60 in higher income countries. The percentages of deaths attributed to NCDs are expected to increase as we approach 2030, especially in low-income countries, as seen in the chart below (WHO, 2011).



Prevalence of these disease states and eventual mortality in younger populations is a big problem for countries that are rapidly developing. Due to globalization and urbanization, people in developing countries are being introduced to the same risk factors that people in high-income countries have. As the economies expand, they are gaining access to cheap food lacking in nutrition, and are being targeted by companies marketing tobacco and alcohol. Physical inactivity is also on the rise. One would think urbanization would be a good thing for these countries, however, the governments are not developing health care infrastructure, policies, laws and services at a fast enough rate. This creates a situation in which younger generations are being exposed to the socio-economic risk factors, but are not receiving healthcare which would help identify these risk factors and perhaps slow the progression of the development of NCDs. Treatment for diabetes, cardiovascular disease, respiratory diseases and cancer especially, can be very expensive. For low-income families, treatment is often not something they can afford. Often middle-income families that do fork out the money for the costly health care are pushed back into poverty. This vicious cycle is something that needs to be broken.

So how do we get a hold on this global epidemic? WHO has taken the lead and is working with countries across the globe to minimize risk factors. They have put together global initiatives to reduce the mortality rate due to NCDs by 2020 – outlined in their Global Status Report published in 2011. Different approaches to reducing tobacco use, alcohol abuse, poor nutrition and inactivity are outlined in the chart below (Hunter, 2013).

Table 1. Opportunities for Prevention, Detection, and Treatment of Noncommunicable Diseases in Low- and Middle-Income Countries.

Level of Approach	Prevention	Detection	Treatment
Government	Anti-tobacco policy; policies that promote reduction in salt intake; regulation and labeling of processed foods and high-sugar beverages; planning for safe, healthy environments that promote physical activity and limit the transition to a sedentary lifestyle; policies designed to mitigate the harmful effects of alcoholic beverages	Promotion of awareness of noncommunicable diseases, their signs and symptoms, and the need for early detection	Policies that ensure access to affordable essential medicines
Health care system	Intersectoral planning for health promotion; training of health personnel, including task shifting for detection and treatment of noncommunicable diseases (e.g., blood-pressure and glycemic control provided by nurses or ancillary health workers)	Surveillance to determine the prevalence of risk factors and noncommunicable diseases; facilities and equipment for low-cost detection of intermediate risk factors (e.g., high blood pressure)	Facilities and equipment for affordable treatments; recognition of the need for both short-term and long-term treatment of noncommunicable diseases
Clinicians	Counseling of patients in risk-factor reduction; treatment of tobacco addiction	Evaluation of intermediate risk factors, coupled with lifestyle and drug interventions to lower risk-factor profiles; appropriate screening (e.g., detection of human papillomavirus)	Evidence-based treatment with affordable essential medicines; procedural or surgical interventions, if appropriate

The key message here is that non-communicable diseases can be prevented through healthy life-style choices and avoidance of the major risk factors. Breaking away from sedentary lifestyles alone can have huge implications including reducing the risk of heart disease by up to 30%, the risk of diabetes by 27%, and the risk of breast and colon cancer by 21–25% (WHO, 2011). Additionally, physical activity lowers the risk of stroke, hypertension and depression tremendously (WHO, 2011). Younger and younger populations are being affected by these diseases, and they are all completely manageable.

Globalization and urbanization should not be a detrimental factor to health. Agencies across the globe are stepping in and implementing programs to combat the rise of these socio-economic risk factors, but it is truly up to the individual to take the initiative to lead a healthy life-style, and help decrease the risk of developing an NCD.

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MEDICAL

THE INCIDENCE, TREATMENT, AND MANAGEMENT OF PATIENTS WITH GASTROINTESTINAL BLEEDING

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Definition: Bleeding that initiates in any part of the digestive tract including small intestine, large intestine (colon), rectum and anus constitute gastrointestinal (GI) bleeding (1). Although there are similarities in the symptoms, the causes and risk factors for GI bleeding can be classified into upper or lower, depending on their location in the GI tract. LGIB is distinct from upper GI bleeding (UGIB) in epidemiology, management, and prognosis.

Lower Gastrointestinal Bleeding (LGIB): LGIB is one of the frequent causes of hospital admission for all ages of patients. Bleeding from sources distal to the ligament of Treitz and superior to the anus falls under LGIB. This includes the last 1/4 of the duodenum and the entire area of the jejunum, ileum, colon, rectum, and anus (2,3). Bleeding can either be acute which is sudden and severe or chronic which consists of slight bleeding that can either last a long time or may come and go (2).

Epidemiology: Although LGIB is statistically less common than UGIB, it remains one of the recurrent causes of hospital admission. For elderly patients, LGIB is a known factor in hospital morbidity and mortality. Globally, acute LGIB accounts for 1-2% of hospital emergencies, with 15% diagnosed as massive bleeding and about 5% requiring operative intervention (4). The annual incidence of LGIB has been reported to be about 20-27 cases per 100,000 population in Western countries and accounts for ~20-33% of all cases of GI bleeding. In United States of America, reports indicate that, cases of LGIB that require hospitalization are less than 1% of all hospital admissions, since it has been found higher percentage of affected patients with LGIB do not seek medical attention (5). The estimated annual incidence of LGIB in the United States was estimated as 20.5 patients per 100,000 (24.2 in males and 17.2 in females) (6). Since diverticulosis and vascular disease are more common in men and in the elderly than in younger people, LGIB has been found to be more prevalent in elderly men than women. The leading cause of significant LGIB in older patients is diverticulosis, accounting for 30-50% of the cases of hemodynamically significant LGIB (7). Although in younger patients (<50 years), the most common cause of LGIB is hemorrhoids and minor bleeding (8).

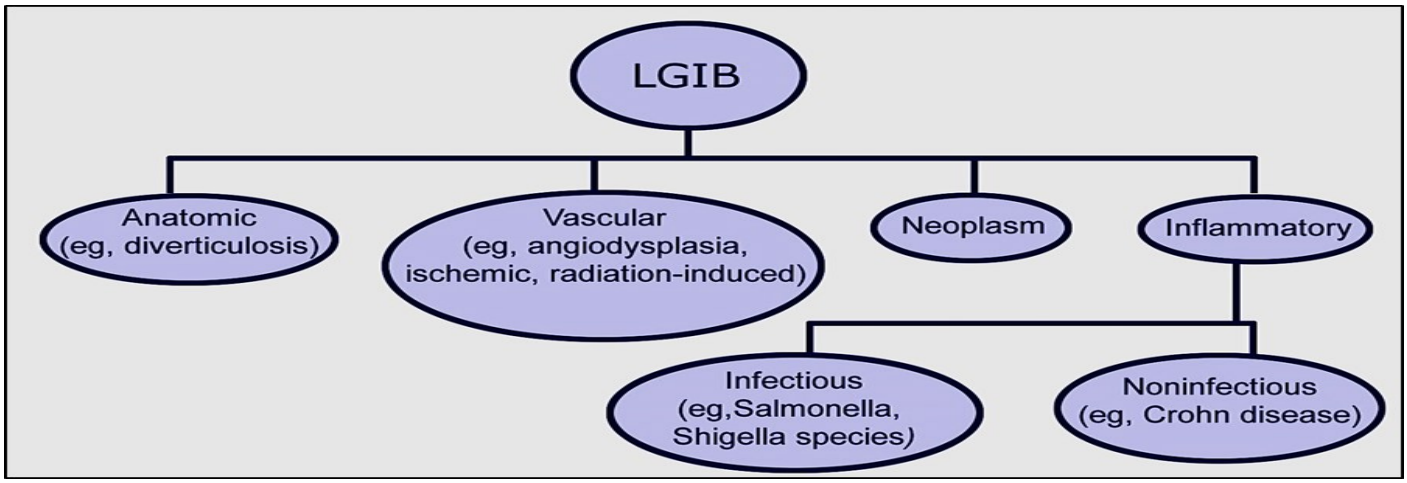
Symptoms: GI bleeding mostly presents as a symptom of an underlying disease or condition, rather than being a disease or condition itself. Most common signs of LGIB constitute hematochezia (passing of bright red blood or clots with stools) or melena (burgundy, black or tarry stools with degraded blood cells). Despite this,

LGIB can be defined with wide range of symptoms, from trivial hematochezia to massive hemorrhage with shock. Acute LGIB results from recent bleeding that originates afar from the ligament of Treitz and is associated with signs of anemia, unstable vital signs and may require blood transfusion. The source of bleeding can be used to cite variations to the clinical presentations of LGIB, such as, bleeding from right side of the colon results in maroon stool and bleeding from GI tract proximal to caecum causes melena. Passage of bright red blood in stools can be caused either due to bleeding from left colon or in patients with UGIB or brisk and massive bleeding associated with right side colon (1,2,3)

The symptoms presented in younger patients with infectious or noninfectious (idiopathic) colitis may range from fever, dehydration and abdominal cramps to Hematochezia. On the other hand, older patients with diverticulosis or angiodysplasia may present with painless bleeding and minimal symptoms. Varying degrees of bleeding have been observed in patients with Ischemic colitis and abdominal pain when presented with multiple comorbidities such as congestive heart failure (CHF), atrial fibrillation or chronic renal failure (CRF). The signs and symptoms can also vary based on the etiology of LGIB (2,9) Based on the patient age, symptoms and etiology, LGIB can be classified into the following types (2):

Lower GI Bleed	Massive	Moderate	Occult
Age	> 65 years	Any Age	Any Age
Symptoms	Hematochezia	Hematochezia or Melena	Microcytic Hypochromic Anemia
Signs	SBP = 90mm/Hg HR >100/min Hgb = 6g/dl	SBP = 90mm/Hg HR >100/min Hgb = 6g/dl	SBP = 90mm/Hg HR >100/min Hgb = 6g/dl
Etiology	Diverticulosis Angiodysplasias	Benign Anorectal, Congenital, Inflamatory, and Neoplastic Diseases	Congenital, Inflamatory, and Neoplastic Diseases
Mortality	As high as 21%		

Etiology: The several causes of LGIB has been shown in the diagram below:



Adapted from: Burt, C., Chico, G. F., Cirincione, E., & Mana, K. J. (2016, Mar 29). Lower Gastrointestinal Bleeding. Medscape

In order to provide better patient management and outcome, a comprehensive understanding of the complete etiology of LGIB is essential (2,10).

Diverticulosis is a dominant etiology of LGIB. It develops when saclike protrusion or pouches (diverticula) form in the wall of the sigmoid and descending colon with bleeding originating from vasa rectae in the submucosa. The risk factors of diverticular bleeding include lack of dietary fiber, constipation, advanced age and use of non-steroidal anti-inflammatory drugs (NSAIDs) and aspirin (2).

Angiodysplasia is one of the most common vascular malformations of the gastrointestinal tract causing lesions in the cecum or ascending colon. The condition in some cases is asymptomatic and in patients over 60 years of age, it may cause GI bleeding (venocapillary in origin) and anemia. Although the bleeding experienced in angiodysplasia is generally less vigorous than diverticular bleeding, 80% of patients with untreated angiodysplasia experience re-bleeding (2,6).

In ischemic colitis, vasoconstriction mediated tissue injury on the left side of the colon does not cause significant blood loss. Hence if LGIB presents with massive bleeding, an alternate etiology should be considered. In many cases, radiation therapy is responsible for mucosal damage to the colon that bleeds. Although this bleeding is not substantial, it can sometimes lead to complications of acute colitis or ulceration (2).

Although massive hemorrhage due to noninfectious (idiopathic) colitis is rare, ulcerative colitis can cause bloody diarrhea in about 50% of patients, and in 4% of the patients massive bleeding was reported. LGIB is not as common in Crohn disease with only 2% patients experiencing massive bleeding. Infectious colitis are mostly caused by *Salmonella* sp., *Shigella* sp., *E. coli* and *Entamoeba histolytica* with symptoms including inflammatory diarrhea characterized by fever, bloody diarrhea, lower quadrant cramps and tenesmus (2).

Colon cancer is one of the leading causes of neoplastic bleeding contributing to 10% of rectal bleeding in patients older than 50 years. Bleeding originates from polyps or carcinoma and is occult in nature. Benign anorectal diseases such as hemorrhoids, fistulas, and fissures, typically causing intermittent rectal bleeding contributes to about 11% of LGIB (2,5). The common etiology of LGIB in adults are summarized below:

Lower Gastrointestinal Bleeding in Adults	**Patient %**
Diverticular disease	**60%**
Inflammatory bowel disease •Crohn's disease	**13%**
•Ulcerative colitis	
Benign anorectal diseases •Hemorrhoids •Anal fissure	**11%**
•Fistula-in-ano	
Neoplasia	**9%**
•Malignant neoplasia of colon, rectum, SI, anus	
Coagulopathy	**4%**
Arteriovenous malformations	**3%**

Adapted from: Vernava III, A. M., Longo, W. E., Virgo, K. S., & Johnson, F. E. (1996). A nationwide study of the incidence and etiology of lower gastrointestinal bleeding. Surgical Research Communications, 18(2), 113-120.

Principles of management: Primarily evaluation in patients presented with presumed acute LGIB should include directed medical history, physical examination and laboratory testing for initial assessment and resuscitation, determining the location and severity of bleeding and therapeutic intervention to stop bleeding (2,3,9). The history should contain the following:

1) Abdominal pain and diarrhea (colitis), altered bowel habits (ischemia) and weight loss (malignancy).

2) Medication use (NSAIDs, antiplatelet agents and anticoagulants)

3) Recent colonoscopy with polypectomy (post-polypectomy bleed) or other operations (possible anastomotic ulcers).

4) Prior cases of abdominal aortic aneurysm with or without surgical repair (possible aorto-enteric fistula).

5) Prior abdominal/pelvic radiation (radiation proctitis/colitis)

6) Alcoholism or chronic liver disease that raises the suspicion for bleeding due to portal hypertension, such as varices

7) Assessments of comorbidities including cardiopulmonary, renal or hepatic disease that may put the patient at high risk of poor outcome and alter the management approach.

Among the components of physical exam and laboratory tests, the following should be included:

1) Vital sign assessment

   a. Orthostatic measurements – to assess for vascular volume status, the severity of the hemorrhage and the need for aggressive volume resuscitation.

   b. Cardiopulmonary, abdominal, and digital rectal examinations – to detect potential anorectal bleeding sources and determine the color of the stool.

2) Laboratory tests

   a. Complete blood count (CBC), serum electrolytes levels, coagulation profile (aPTT, PT, platelet count).

   b. Blood Urea Nitrogen (BUN), creatinine - An elevated BUN-to-creatinine ratio suggests an UGIB source whereas red blood and clots are unlikely to be from an upper gastrointestinal source .

   c. If the likelihood of UGIB is high, an upper endoscopy should be performed.

3) Assessment of potential cause of the bleeding – since brisk UGIB can present as LGIB, a nasogastric (NG) tube may be necessary. The aspirate or lavage should be examined for the presence of blood and bile. A positive nasogastric aspirate indicates a very high likelihood of UGIB. As diagnostic tests for localization of the bleeding site, computed tomographic (CT) angiography can be considered.

4) Patients suffering from rectal varices with portal hypertension may develop painless massive LGIB. Thus, early examination of the anorectum is important. If active bleeding is identified, aggressive treatment is important (2,3,9).

Hemodynamic resuscitation: Normalization of blood pressure and heart rate before endoscopic evaluation is absolutely necessary. Patients with hemodynamic instability and on-going bleeding should receive intravenous fluid resuscitation. Packed red blood cells (RBCs) should be transfused to maintain the hemoglobin above 7 g/dl. In patients with massive bleeding, or with significant comorbid illness (especially cardiovascular ischemia) or in case of a possible delay in receiving therapeutic interventions, 9 g/dl should be used as a lower limit (3).

Management of coagulation defects: In patients with LGIB, administration anticoagulants and antiplatelet medications require a case-by-case evaluation due to the continued risk of ongoing bleeding and thromboembolic events. Literature standards in hematology have identified that, in patients with massive bleeding, platelet count of ≥50×109/l should be maintained during platelet transfusion. In case of target-specific oral anticoagulants including dabigatran, rivaroxaban, and apixaban, which are associated with increased risk of GI bleeding, washout period

based on the drug half-life is recommended, especially in patients not suffering from ongoing, acute bleeding or not at high risk of thromboembolic events. A reversal agent for dabigatran (idarucizumab) was recently approved by the Food and Drug Administration (FDA) and several other such agents for non-vitamin K anticoagulants are currently in development. In patients who are on target-specific oral anticoagulants, standard clotting tests cannot be used to guide the safety of standard endoscopic procedures (3,9).

Measures to prevent recurrent lower GI bleeding: Use of non-aspirin NSAID should be avoided in patients with a history of acute LGIB. Although for most LGIB patients, aspirin as a primary prevention of cardiovascular events should be avoided, in patients with high-risk cardiovascular disease and a history of LGIB, aspirin for secondary prevention can be continued. In patients on dual antiplatelet therapy or monotherapy with non-aspirin antiplatelet agents (thienopyridine), non-aspirin antiplatelet therapy should be resumed as soon as possible along with aspirin use.

Endoscopy, Colonoscopy and Sigmoidoscopy: A frequent sign of upper gastrointestinal bleeding is the acute massive rectal bleeding. If there is an evidence or clinical suspicion of an upper gastrointestinal source of bleeding, first an esophagogastroduodenoscopy (EGD) should be performed which will evaluate lesions above the ligament of Treitz (12). Endoscopic clips and endoscopic bands can be used in the treatment of diverticular bleeding. Clips can be positioned over a bleeding vessel at the neck of the diverticulum or to resist the walls and close the diverticular orifice, thereby halting bleeding. Ligation with endoscopic bands has also been reported to treat diverticular bleeding in some small series of patients (13).

Colonoscopy is one of diagnostic tools used to evaluate acute LGIB. Several medical studies have validated that colonoscopy identifies definitive bleeding sites in more than 70 percent of patients (12). Once patient with acute LGIB is hemodynamically stable, colonoscopy can be performed as both diagnostic and therapeutic measure. Colonoscopy helps identify the site of bleeding and perform hemostasis if needed. In order to identify the site of bleeding, during both colonoscope insertion and withdrawal, colonic mucosa should be carefully inspected and residual stool and blood washed vigorously (3,9,10).

The most common pattern of LGIB is the chronic intermittent passage of small amounts of blood per rectum with anorectal or distal colon as the source of bleeding. For healthy patients aged > 40 years, a digital rectal examination and flexible sigmoidoscopy, with or without anoscopy, may be sufficient for the evaluation of the source of bleeding. A sigmoidoscopy is a procedure to view the lower 20 inches of a patient's sigmoid colon and rectum. In patients with minor rectal bleeding, sigmoidoscopic examinations should be performed for the diagnosis and prognosis along with further histopathological confirmation of the diagnosis (14).

Medications:

Vasopressin – Vasopressin or antidiuretic hormone (ADH), is a pituitary hormone, known to regulate water reabsorption at the distal renal tubular epithelium, thus maintaining the volume of water in the extracellular fluid and playing a key role in maintaining osmolality. It also promotes smooth muscle contraction or severe vasoconstriction in the renal tubular epithelium

Vasopressin is used to decrease the portal pressure in portal hypertension. However, simultaneous use of nitrates may be required to prevent cardiac ischemia by coronary artery constriction.

Epinephrine - Epinephrine also known as adrenaline, is a hormone, neurotransmitter and can be used as a vasoconstrictor in treatment of diverticular bleeding or post-polypectomy hemorrhage. Epinephrine acts as a non-selective

agonist of a and b adrenergic receptors by binding to them and causing a wide variety of effects such as increased peripheral vascular resistance, reversed peripheral vasodilatation, systemic hypotension, bronchodilation and positive inotropic effects. Usually, a 1/1000-epinephrine solution can be injected into bleeding site at the time of the endoscopic evaluation (2).

Mesalamine – Aminosalicylates has been traditionally used as frontline therapy for ulcerative colitis. Sulfasalazine, the parent compound for aminosalicylates, combines an antibacterial agent (sulfapyridine) with an anti-inflammatory component (5-ASA). This sulfonamide moiety works as a carrier in delivering the active component 5-ASA to the colon, where colonic bacterial enzymes are required to release it. Due to the poor tolerance of the sulfapyridine carrier molecule, newer formulations composed of 5-ASA, the active moiety of sulfasalazine, have been developed to optimize dosage for efficient therapy. Mesalamine-based drugs show reduced side effects with targeted delivery and proximal earlier release in the small intestine. Several mechanisms have been studied by aminosalicylates reduce inflammation. The primary mechanism incorporates the reduction of prostaglandins and leuokotrienes following the inhibition of cyclooxygenase and lipoxygenase pathways respectively. Mesalamines have also been known to reverse the antiproliferative effects of TNF-alpha and reduce the intestinal cell transcription of inflammatory mediators. Other mechanisms include inhibition of platelet activating factor and production of oxygen radicals and other anti-inflammatory factors. Significant lessening in the chronic inflammation by mesalamine has been shown to involve decrease in the production of inflammatory prostaglandin and the formation of other potent chemotactic substances including leukotriene B4 and certain hydroxy fatty acids. Regarding effective dosage, 80% of patients receiving daily doses of 4–6 g have manifested complete clinical remission or significant clinical improvement within 4 weeks of treatment with mesalamine. Daily doses of 1.6 g and 2.4 g have also indicated higher overall clinical response rates than observed with placebo (11).

Non-colonoscopy interventions – In patients with ongoing bleeding and high-risk clinical features, surgical intervention may be considered after other therapeutic measures have not yielded significant results. The factors to take into inconsideration are extent and success of prior bleeding control measures, severity and source of bleeding and the level of comorbid disease. Localization of bleeding source and site absolutely necessary to avoid continued or recurrent bleeding (3).

Radiographic interventions are considered for clinically high-risk patients with ongoing bleeding who show negative upper endoscopy. Such interventions are also recommended for patients do not respond to hemodynamic resuscitation and cannot tolerate bowel preparation and urgent colonoscopy (3).

Conclusion: In this article, the symptoms, epidemiology, etiology and management of patients affected with LGIB was evaluated. To summarize, LGIB is defined as bleeding that initiates in distal to the ligament of Treitz and superior to the anus. The major symptoms can range from hematochezia, melena to massive hemorrhage with shock. Diverticulosis, angiodysplasia, IBD and neoplastic bleeding are the common etiology of LGIB. Patients displaying acute severe hematochezia should be provided with a focused evaluation synchronized with hemodynamic resuscitation. The first choice in most cases of acute hematochezia is colonoscopy following a colon purge. Patients with brisk bleeding who are not sufficiently stabilized for colonoscopy can undergo radiographic interventions. Antiplatelet and anticoagulant medication management demands a multidisciplinary, case-by-case approach that takes into account the risk of a thrombotic event along with LGIB. Medications like vasopressin, mesalamine and epinephrine can be used to counter LGIB provided assessments of comorbidities have been performed.

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FIREFIGHTER DOWN CPR: A NOVEL TECHNIQUE TO EFFICIENTLY DOFF TURNOUT GEAR AND A SELF-CONTAINED BREATHING APPARATUS FROM AN UNRESPONSIVE FIREFIGHTER

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Introduction

Approximately 100 firefighters die in the line of duty each year in the United States [1]. The most common cause of firefighter fatalities is sudden cardiac arrest, of which half are due to cardiovascular disease [2]. While training to remove downed firefighters from hazardous situations is common, there is no structured training available to direct care once they have been brought to awaiting medical personnel. Furthermore, undirected attempts at removing firefighters from their turnout gear is difficult and time consuming owing to its unfamiliarity among medical personnel, overall bulk, and the large SCBA bottle on their back. In this article we discuss the etiology of firefighter fatalities, physiological effects of firefighting, and a novel approach to doffing gear from an unresponsive firefighter. Our approach is simple, requires no additional equipment, and can be reliably performed in less than one minute.

Discussion

Etiology of Firefighter Fatalities

In 2013, 107 firefighters died in the line of duty of which 37 were attributable to acute myocardial infarction [3]. Reviewing line of duty death (LODD) reports from the past 20 years shows that almost 39% of all LODDs among firefighters have been from heart attacks. Heart attacks account for the single most common category of LODD among active firefighters [1].

Physiology of Firefighting

Personal fitness and the overall health status of an individual firefighter is an important comorbid factor and needs to be addressed; however, the belief that all of these fatalities result from modifiable lifestyle choices is not a fair nor complete assessment. Firefighters perform strenuous work in heavy gear while being subjected to extreme environments. The cardiovascular workload encountered is not unlike running a marathon, except in a situation where the ambient temperature may exceed 160 C. This cardiovascular and thermal strain experienced during firefighting alters myocardial function and blood chemistry, placing firefighters at roughly 10 to 100 times the risk of sudden cardiac arrest [4].

Noxious arousal

Even before stepping onto the fire ground, alterations in myocardial function may occur. Studies of healthy subjects have shown that during the alarm response, T-wave inversions on the ECG can be noted [5]. Immediate arousal such as a sudden fright or being woken from sleep can result in cardiac arrhythmias in susceptible individuals such as those with ischemic heart disease or the congenital long QT syndrome [3]. The T-wave inversion seen

following the first few minutes of an alarm activation, "coincides with changes in autonomic tone, heart rate (HR), blood pressure, and catecholamine levels and a greater likelihood of ischemia" [5] which accounts for the abnormal adaptation of repolarization [5]. This phenomenon of "noxious arousal" may be a contributing factor in incidences of sudden cardiac deaths in the early hours of the morning [3].

Cardiovascular impact of fire suppression activities

Once fire suppression activities occur, the combination of cardiovascular and heat strain, coupled with the psychological stress, contributes to increased sympathetic drive and catecholamine release compared with standard exercise alone [6]. Firefighters not only attain maximal heart rate, elevated body temperature and dehydration, they also experience alterations in myocardial function that potentially decreases their tolerance for strenuous activity.

Assessment of the vascular function of firefighters during fire suppression activities has been performed in studies measuring Rate Pressure Product (RPP) and Subendocardial Viability Ratios (SEVR). These serve as a measurement of the myocardial oxygen consumption and the arterial system's ability to supply oxygen to the heart muscle, respectively. While performing fire suppression duties, firefighters have a significant increase in rate pressure product (RPP), which reflects an increase in the myocardial tissue demand for oxygen while suffering from a decrease in myocardial perfusion relative to the cardiac workload, or a reduction in the SEVR. We can speculate that this results in an imbalance in myocardial perfusion and perhaps raises the potential for cardiovascular collapse. Unfortunately, research is limited in this regard and there is no definitive answer to this question.

Hematological and blood chemistry changes during fire suppression activities

It is unknown what portion of firefighter line of duty deaths from sudden cardiac arrest are thrombo-occlusive versus arrhythmogenic in nature [7]. In addition to the cardiovascular disruption experienced by firefighters when engaged in fire suppression activities, the hematological and blood chemistry changes need to be taken into consideration as well. Despite its critical importance in acute coronary syndromes, there is only limited research that has investigated the direct effects of firefighting on the hemostatic system [8]. Advocating for this type of research should be a key objective of stakeholders in the fire service industry. It is known that firefighters may have significant comorbidities and lifestyle risks (CDC 2006, Yang 2013) similar to the general population which places them at risk of thrombotic events. The sympathetic activation experienced during firefighting stimulates release of platelets from the spleen and lymphatic tissue [8]. This increase in platelet numbers, and the decrease in platelet closure time that occurs from the same sympathetic response means that platelet aggregation is significantly enhanced [2]. Coupled with a plasma shift of 5-15% [2,8] and dehydration that occurs, firefighters experience a significant pro-coagulatory state during fire suppression duties. To complicate matters, there is also evidence that coagulation and fibrinolytic factors may become unhinged. Although fibrinolysis is enhanced during firefighting to compensate for the increase in coagulation, evidence suggests that these factors returned to baseline values post-firefighting much faster than the coagulatory factors. This means that the coagulatory potential is highest hours after fire suppression duties cease. This possible mechanistic link could account for the disproportionate number of firefighters fatalities from sudden cardiac events after strenuous fire suppression activities [2].

Toxic exposures

Many chemicals known to be carcinogens are ubiquitous at structure fires. Firefighting is

directly related to a number of cancers in the United States; however, of immediate concern during firefighting activities are two common toxins--carbon monoxide (CO) and hydrogen cyanide (HCN). Hazardous levels of these chemicals have been recorded outside structure fires where firefighters routinely do not use their SCBA [9,10].

Carbon monoxide is a colorless, odorless, and tasteless toxin that combines with hemoglobin to produce carboxyhemoglobin, which prevents the proper delivery of oxygen to tissues.Hydrogen Cyanide is a colorless and extremely toxic compound that causes a condition known as histotoxic hypoxia in which the enzyme cytochrome c oxidase in the mitochondria of a cell is inhibited in using oxygen to produce ATP, despite physiologically normal delivery of oxygen. These two chemicals work synergistically to multiply their toxic effect. They are often referred to as the "Toxic Twins." In combination or separately, these toxic effects firefighters are likely to suffer are extremely dangerous and requires specific treatment with antidotes like hydroxocobalamin and hyperbaric oxygen therapy.

Conclusion

Given all of these factors it is easy to see why heart attacks alone are as prevalent as death from traumatic injury. Prevention, recognition and effective early medical treatment is paramount to prevent future Line of Duty Deaths (LODD). When a sudden cardiac arrest occurs in a firefighter, standard resuscitative efforts should be initiated quickly with extra consideration given to potential differentials, such as cyanide toxicity and asphyxia. We know that good neurological outcomes can be had in out of hospital cardiac arrest provided high quality chest compressions are initiated early. Unfortunately, the resuscitation of a downed firefighter presents a special concern because that firefighter may present to medical care providers donned in full protective turnout gear and a Self-Contained Breathing Apparatus (SCBA). Proper treatment will have to be delayed until the protective gear is removed. Unfortunately, most medical providers that are not cross-trained in fire suppression have little to no experience in the cumbersome turnout gear fire departments use. Even experience firefighters have trained little on any gear removal technique of a downed firefighter. Undirected attempts at removal of turnout gear is time consuming and chaotic. It may require up to a minute in the best case scenario, and potentially a few minutes prior to a point when effective chest compressions can be initiated. Since the potential of a sudden cardiac arrest of a firefighter in full turnout gear with and SCBA is not only likely, but probable, a clear, easy approach to reduce no-flow time and subsequent doffing of gear needed to be developed.

FDCPR Technique

The Firefighter Down: CPR (FD-CPR) technique is broken down into a few general steps that focuses on the stabilization of the downed firefighter in full personal protective equipment (PPE).

- After removing the downed firefighter from any hazards, the initial rescuer grasps the shoulder straps of the victim and sits down, dragging the victim along their SCBA in between the rescuers legs.
- Next, a second rescuer removes any obstructions from the chest, opens the top of the turnout coat, and begins chest compressions. Because the victim is resting flat on their rigid SCBA backplate, chest compressions can be performed.
- The next steps occur concurrently and require at least one additional rescuer. While rescuer 1 removes the victim's helmet, mask, and hood, a third rescuer opens the turnout coat from the bottom up, minimizing interference

with chest compressions. After the turnout coat is fully open, rescuer 1 loosens the SCBA shoulder straps and the victim's wrists in their turnout coat, working with rescuer 3 to position the victim's arms above their head. At this point, rescuer 1 holds the victim's arms and turnout coat, preparing for the final maneuver.

- The final maneuver in FD-CPR is the coordinated "pull down" of the victim by the third and possibly fourth rescuer. The victim's legs are grasped and they are pulled away from their turnout coat and SCBA while the first rescuer holds the victim's turnout coat arms.

This effectively removes the downed firefighter from their turnout coat and SCBA all at once. From start to finish, the steps of FD-CPR should take no longer than 15 to 30 seconds, and in practice can be done in less time. Once the victim is extricated from their gear, EMS personnel can join in beginning a comprehensive resuscitation bundle.

It is the author's opinion that pulse checks and the application of an AED or manual defibrillator be delayed until this stage, as during prior steps they may interfere with chest compressions and removal of turnout gear. Identifying the need to provide compressions should be based on assessing level of consciousness and breathing. In other words, if the downed firefighter is unresponsive and not breathing, or breathing abnormally, they are suspected to be in cardiac arrest.

A training video demonstrating this technique can be found online under the tags: "firefighter down cpr" and "fdcpr" on YouTube, or directly on the FDCPR website at www.fd-cpr.com

Limitations

In the author's experience, and after correspondence with numerous firefighters, a number of limitations have been identified with this technique. While there is a standard for PPE among firefighters, no two brands of turnout gear or SCBA's are the same. During the pull down step certain gear may become hung-up on the victim's wrists due to elastic bands or wristlets. In many cases the victim may only become partially free, which is not optimal, but if their shoulder blades are flat on the ground this still allows effective chest compressions. Other gear has metal clips on the chest in addition to or instead of Velcro and zippers. These metal clips may be quite hot if a firefighter is removed from a working structure fire, requiring heavy gloves to touch them. Manual dexterity is greatly reduced while wearing structural firefighting gloves, complicating the removal of the turnout coat, which will likely be compounded by the loss of fine motor control during the psychological stress of rescuing a fellow firefighter. Because of the variety of gear in use today, FD-CPR cannot be an out-of-the-box solution for all fire departments. However, after careful training with their specific equipment the general process can be adapted for any department's gear.

Summary

In conclusion, we present Firefighter Down: CPR (FD-CPR) a novel technique to doff gear from unresponsive firefighters which has not been previously described. This technique focuses on rapidly stabilizing the firefighter on their back to enable chest compressions while other rescuers focus on removing the gear. FD-CPR is simple, requires no additional equipment, and can be executed quickly ensuring that chest compressions can be initiated early with minimal no-flow times, essential goals for a firefighter in cardiac arrest.

<u>Resources</u>

Additional training material, including instructional videos can be found at www.fd-cpr.com and on all major social media platforms under the hashtag #FDCPR. You may contact

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THE BLACK ROCK CITY EMERGENCY SERVICES DEPARTMENT: PROVIDING EMERGENCY CARE IN A UNIQUE ENVIRONMENT

ANDREA COOPER

Population of Black Rock City, Nevada, as of April 2017: 0

Estimated population of Black Rock City, Nevada, on August 31, 2017: 70,000

Black Rock City, Nevada, is a temporary city that exists for only one week per year. It's the home of the annual Burning Man event, "a temporary metropolis dedicated to community, art, self-expression, and self-reliance" (www.burningman.org/event)

For most attendees, Burning Man is a fun – though challenging – one-week adventure: a combination of mind-blowing art event and "extreme" camping trip. Think daily highs that regularly exceed 100° F (40° C) and overnight lows that can drop into the 40s (5-10° C). Throw in occasional "white outs" caused by dust storms, and rain storms that turn "the playa" – the dry lake bed on which the event takes place – into a field of mud. Then consider that there are no supply vendors at the event, so "Burners" have to bring in everything they need –water, food, and shelter – to survive in the harsh, arid Black Rock Desert environment.

Obviously, simply attending the event requires careful planning. For the team charged with protecting the health and safety of attendees, that challenge is multiplied exponentially. How do you go about standing up emergency services for 70,000 people in a remote location two hours from the nearest airport (Reno, Nevada) and more than 10 miles from the nearest village (Gerlach, Nevada)?

EMS White Paper spoke with Kate Gonnella, Chief of Emergency Services, about the enormous effort involved in maintaining public health and safety at Burning Man.

The Volunteer Emergency Services Team

Kate leads an Emergency Services department that numbers approximately 1400 volunteers, about 650 to 680 of whom attend the event in any one year. (In 2016, there were 677 ESD team members on the playa.) Most are trained, licensed professionals. What's more, all must have at least one "burn" under their belt.

Kate explains why first-year "Burners" are not admitted to the team: "When you go to Burning Man, people can tell you about it all they want, but there is nothing like being there in that heat, with that dust, having to manage all of your things – your food and your water – getting sleep-deprived because the theme camp next door is so loud that you never really get a great night's sleep...

"Not everybody is cut out for that. What we've found is that, if we bring a first-year person on, somebody who's never been to the event before, it's sometimes just too much. It isn't what they were expecting. They get a day or two into it, and they say,

'I'm going home. What I read about Burning Man, it was way more glamorous than this. I'm tired of having dust in every crevice. I'm tired of being thirsty and tired...'"

Qualified volunteers who have who survived at least one year of Burning Man attendance are organized into the following emergency teams:

- The Medical team includes licensed providers such as doctors, nurses, EMTs and paramedics, physician's assistants, and nurse practitioners. Team members serve at six medical stations strategically located throughout the playa, equipped with cots and basic medical supplies. They also provide First Responder care in the field.
- The Fire team operates two Type 6 engines with 300 gallons of water and a three to four person crew. They put out car fires, trailer fires, and provide technical rescue. They also have a Hazardous Materials and Rescue response rig with a four-person team. Because art "burns" large and small are an integral part of the Burning Man experience, the Fire and Medical branches provides Rapid Intervention Teams (RITs) that secure the perimeter of burns and stand by in case any intervention or rescue is needed.
- The hand-picked Crisis Intervention Team provides mental health services. They deal with, in Kate's words, "somebody who's having a melt down." They also provide expert support for domestic violence and sexual assault incidents, though rare. The team includes psychiatrists, psychologists and therapists, all with a significant amount of crisis intervention experience.
- The Communications team consists of dispatchers and IT personnel.
- The Logistics team manages pre- and post-event set-up of emergency facilities, EDS-related recycling and trash management during event, and delivery of meals to medical stations for on-duty personnel.
- The Planning department handles ESD volunteer check-ins, issues laminates, and generates daily SitStat (Situation Status) reports.

Kate points out that because there isn't a lot of time to provide training on the playa, much of the preparation takes place off-playa via their volunteer website and blog, where volunteers can find online orientations and, in some cases, take tests. Once volunteers arrive at the playa and show up for their first shift, they receive additional orientation and are given the opportunity to ask questions.

Pictured Above: The Emergency Services Team preparing for a controlled burn on the playa

"The bottom line," says Kate, "is that when you are a professional, when you're doing medical or fire or crisis intervention, there's an element of cookie cutter-ness to it. They're taking what they already know and do so well, and they're applying it to a different environment. We don't have to teach them all of that. We have to teach them things like, 'Tape isn't going to work as well as coban when you're wrapping up a wound because tape will just turn into a hot mess, whereas coban will stay on.' We take the things they already know and we give them information to help them

do it in this really different environment that's so austere and challenging."

When asked what makes a successful ESD volunteer, Kate replies, "Honestly, people that are firefighters and care providers already have what it takes; they wouldn't be in their profession if they didn't. We trust that. We do prefer staffing our field units with people that work in the field, like paramedics or EMTs. We try to put people with an emergency background into the clinic because they're more attuned to the immediacy of the event, and tend to be more resilient in a harried environment. For instance, an ER doctor or nurse who's worked in Rwanda or done remote work in Guatemalan villages is going to be a better fit than, say, a urologist."

Pictured Left: One of six on-site medical tents.

Additional Vendor Support

The Burning Man organization supplements its emergency staff by contracting with two outside vendors. Unlike ESD team members, vendor personnel are paid for their services.

- The contracted Medical Services vendor runs a State-certified onsite Emergency Care Center called Rampart. The clinic is erected the week before the event. Its staff of about 150 offers a full range of medications, hydration, suturing, and casting for simple fractures. (Attendees with complex fractures are sent to the hospital in Reno to see an orthopedist.) In 2012, the clinic added radiology and diagnostics capabilities, including i-STAT laboratory studies. The medical services vendor also provides a fleet of 10 ambulances and one air ambulance to transport patients to Reno if needed.
- The contracted Fire Support vendor, Lightning Suppression, brings a crew of about 50 firefighters, five Type 2 tenders, one Type 1 engine and one Type 6 engine with a total of about 55,000 gallons of fire fighting water capacity onto the playa.

An ICS-based Model

Because Burning Man takes place on public land in Pershing County, in addition to coordinating with other Burning Man teams and the contracted vendors, the ESD team works closely with the Nevada office of the U.S. Bureau of Land Management (BLM), the Pershing County Sheriff's Office, the Nevada Department of Health, and Nevada EMS.

The organizations all work together using an Incident Command System (ICS) model. Kate explains that the Burning Man organizers, ESD teams and the government agencies usually meet a couple of times before the event. Together, they work through an ICS tabletop exercise to clarify roles and responsibilities and to identify additional mitigation and preparedness needs. "We'll run a scenario," Kate explained. "Last year it was an airplane crash on the playa. Our people that are running the tabletop will put together a timeline: Whom would you deploy next? Who would get involved now? We talk through what we would do, as a group, to make sure we're all on the same page about how we would manage a large-scale incident."

The ESD and vendor teams meet every morning at 9:30 when they're out on the playa "to talk about the operations from the day before and what are our anticipated hot spots will be for the day coming up." Each afternoon, Emergency Services, BLM, Pershing County sheriffs, key Burning Man stakeholders, and the managers of various Burning Man teams get together to collaboratively review any incidents that took place the day before and discuss whether they were managed correctly and what they would do differently next time. Then, on the very last day of the event, the entire team meets to review the event while it's still fresh in their minds.

A Balancing Act

When asked about the biggest challenge of providing emergency care at Burning Man, Kate replies, "Some of our people get frustrated because they want to be able to give more, but you can only provide so much up there. For instance, two years ago, the medical vendor wanted to bring a CT scan machine up there. We really had to think about that. Certainly, it would diagnose that random stroke that might happen, or an abdominal aneurysm or something like that, but is that the best use of our time, energy, and money, or are there other ways we can enhance what we do? One of the things we have committed to is making sure we can get people rapidly down to Reno if we need to so that we don't feel like we have to have all of those services up on the playa.

"As you can imagine," she summarizes, "it's a real balancing act trying to figure out just the right amount to do... to try to hit that sweet spot."

Not What You'd Expect

So, what types of emergencies does the ESD team commonly deal with? You may be surprised by the answer. "There's a misconception that Burning Man is just this big drug fest," says Kate, "but it's really more of an art fest. Certainly there are people that come to the event with the intention of getting high, but that's not your average person." The average person, she observes, wants to participate in the Burning Man experiment in community, to be part of something that's "profound and different." In fact, drug- and alcohol-related incidents make up less than one percent of total emergency events.

Surprisingly, dehydration is another condition that comprises less than 10 percent of incidents.

"Most of the things we see," notes Kate, "are injuries. We see a lot of cuts and twists, things like that. It's the accidents that really get us. People are there taking great care of themselves, but then they smash their finger with a hammer or fall off a ladder or something like that, and they end up coming to see us."

Every year, something happens on the playa to generate a rash of injuries – sometimes literally. Kate recalls a piece of art called The Wedge – essentially, a huge wedge-shaped slide covered with astroturf. There were no safety railings on the sides, nor was there anything to sit on while sliding.

"What ended up happening when the event opened and people started going up on this thing," Kate recollects, "is that we were spending all of our time at our stations dealing with butt rash and falls. We had to go over there and ask them to add some railings so that people wouldn't fall, and to bring cardboard up there – do something to stop people from hurting their butts, because we had so much road rash that it was overwhelming our medical department.

"Every year it's something. We all laugh about it, but it needs to be mitigated."

Pictured Above: Eyewash Station

2016 Incident Summary

4383 patients seen at ESD first-aid stations
494 ambulance calls for service
1894 patients seen at the Rampart clinic
33 patients transported off-playa

Soft tissue injuries were the most common complaint (969), followed by eyes, ears, nose, throat (680) and lacerations (579).

There were 71 alcohol and drug related complaints, affecting about 0.01% of the population.

Andrea Cooper is a writer, editor, and consumer engagement pro with experience in industries including health care, finance, education, and worker safety, for companies ranging from dotcom startups to leading US and international corporations.

Thoughts?

Comments?

We would like to hear from you!

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