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Works Cited

Nasiruddin, Melissa, et al. "Zombies--A Pop Culture Resource for Public Health Awareness." *Emerging Infectious Diseases*, vol. 19, no. 5, May 2013, p. 809. *EBSCOhost*, doi:10.3201/eid1905.AD1905.

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Zombies--A Pop Culture Resource for Public Health Awareness

ANOTHER DIMENSION

Sitting at his laboratory bench, a scientist adds mutation after mutation to a strand of rabies virus RNA, unaware that in a few short days, an outbreak of this very mutation would destroy society as we know it. It could be called "Zombie Rabies," a moniker befitting of the next Hollywood blockbuster--or, in this case, a representation of the debate over whether a zombie apocalypse, manufactured by genetically modifying one or more diseases like rabies, could be more than just fiction. Fear of the unknown has long been a psychological driving force for curiosity, and the concept of a zombie apocalypse has become popular in modern society. This article explores the utility of zombies to capitalize on the benefits of spreading public health awareness through the use of relatable popular culture tools and scientific explanations for fictional phenomena.

Although zombies are currently an integral part of our popular culture, our morbid fascination with the walking dead spans several centuries. Historians and anthropologists trace the origin of zombies to the folklore of several tribes in western Africa, from Ghana to Nigeria (1, 2). During the slave trade of the late 1500s through the 1800s, persons from these regions were spirited away from their homes to till the plantations of the Caribbean and the European colonies, bringing with them the voodoo culture of magic and spells. Among some academics, zombies in the New World were thought to be wretched, half-dead creatures that reflected the bondage African-born and Caribbean slaves suffered at the hands of their masters, working to the point of exhaustion in the plantation fields while having little to no agency (2). To this day, voodoo is prominent in western Africa, Haiti, New Orleans, and parts of the Caribbean Islands (1).

Haitian voodoo folklore recognizes a dual identity of zombis: one form of zombi is an ambulatory body without a living soul, and the other, lesser-known form is a soul wandering without a body (2). This severance of a body and its soul, known as zombification, is thought to occur when a sorcerer, or boko, performs a combination of dark magic spells on a person to kill, enslave, or inflict illness upon him (3). Bokos may also use poisonous powders in which frog or toad venom and tetrodotoxin, a powerful neurotoxin secreted by puffer fish that can trigger paralysis or deathlike symptoms, could be primary ingredients. Which toxins are used in the zombie powders specifically, however, is still a matter of contention among academics (4). Once the sorcerer has split the body and soul, he stores the ti-bon anj, the manifestation of awareness and memory, in a special bottle. Inside the container, that part of the soul is known as the zombi astral. With the zombi astral in his possession, the sorcerer retains complete control of the victim's spiritually dead body, now known as the zombi cadavre. The zombi cadavre remains a slave to the will of the sorcerer through continued poisoning or spell work (1). In fact, the only way a zombi can be freed from its slavery is if the spell jar containing its ti-bon anj is broken, or

if it ingests salt or meat. The latter would usually cause the zombi to hunt down and kill its master before finally returning to its family or its final rest as a corpse (1, 2).

Although most cultures would consider the zombie to be a fictional creature, zombiism (i.e., being a zombie) is rather common in Haiti, with instances of people being reported dead by loved ones, only to be spotted fully reanimated and wandering around town several weeks to several years later. In Haitian and African culture, zombification is a punishable offense on the same order of severity as murder (1). A person who has been zombified, or transformed into a zombie, can have a blunt affect, dull gaze, and almost stuporous behavior, characterized by a lumbering gait and simple, repetitive vocalizations and movements. Most medical evaluations would characterize victims of zombification as having mental disorders such as catatonic schizophrenia (1). The aforementioned traits have been incorporated into the current interpretation of zombies found in modern film and media.

History of Zombies in the Media

Zombie folklore made its appearance in modern media in *Das Cabinet des Dr. Caligari*, a silent horror film directed by Robert Wiene, which debuted in Germany in 1921. The film's depiction of zombies paralleled Haitian lore: a sleepwalker under the control of another individual. The notion of a zombie was primarily defined by the control an individual had over another, and the main character in this film had the characteristic attributes of the early zombie: the unique lumbering gait, lack of higher cognitive ability, and obedience to another individual.

Drawing inspiration from Richard Matheson's 1954 novel *I Am Legend*, George A. Romero spawned the more modern film manifestation of the undead zombie and the notion of a zombie apocalypse in *The Night of the Living Dead*. These zombies were the corporeal expression of strife, a mechanism to demonstrate rising social tension in response to a ruinous threat. Subsequent media have continued to use adaptations of Romero's zombie. The film adaptation for *I Am Legend* depicts humans who have undergone physiologic changes, developing intolerance for the sun and a unique form of communication while maintaining the ability to learn through mimicry and form social hierarchies. In the film *28 Days Later*, infected humans transform into creatures characterized by preserved intellect and tremendously aggressive behavior. However, this expansion of aptitude is not uniform in modern media: *Shaun of the Dead* portrays zombies as very slow-moving, with incredible strength but no intelligence--they are fooled by normal humans who mimic their gait and groans. In addition, *Juan of the Dead* includes zombies dismissed by the Castro government as dissidents, and *Warm Bodies* depicts zombies as human protectors once they begin to transform back into humans. *Land of the Dead* revolves around the zombie siege of a noninfected gated community and sees the leader of the zombies gain class consciousness toward the end of the film. None of these interpretations are necessarily out of step with the use of zombie movies as a useful public health messaging tool.

Though most popular in film, zombies are present in other forms of media as well. They can be found in print, with novelizations such as *Zombies for Zombies: Advice and Etiquette for the Living Dead* and the popular comic book series *Marvel Zombies*. Increasingly, however, these flesh-eating monsters have found themselves in videogames, feasting upon unwary protagonists since the introduction of *Zombie Zombie* in 1984 (5). Zombies have since spread to the more general population in games such as *Plants versus Zombies* and *Resident Evil*, available on several different platforms of accessible technology.

A brief look through the history of the zombie's evolution within media unearths their progressing ability to serve as a vehicle to reach greater audiences. Frank Darabont's award-winning television adaptation of *The Walking Dead* comic books has proven that zombies maintain thematic prominence even when serving as the backdrop to a character-driven television drama. In his critically acclaimed novel *World War Z: An Oral History of the Zombie War*, Max Brooks explores social issues surrounding zombie apocalypse, such as the efficacy of government. These popular and varied manifestations of zombies elucidate the potential for a comprehensive dissemination of knowledge, from identifying traits indicating infection to explaining the significance of public health infrastructure. Zombies are a unique medium that allow for the audience's suspension of disbelief and for intellectual engagement.

Zombies and Parallels with Other Public Health Issues

Although zombies are certainly not the only favored supernatural creatures in modern times, they appear to be the best conduit to educate the layman about reemerging infectious diseases such as rabies. The current popular interpretation of vampires, for instance, has shifted away from the classic grotesque undead creature that voluntarily dines on the vein and sires new vampire progeny and instead has embraced the idea of vampirism as the paragon of human existence, alive or undead. The interpretation of zombies has been diverse, but at its core, zombiism remains an existence in which the victim has been stripped of any higher consciousness or agency. The reimagining of zombiism as a virulent, incurable disease makes it an effective analogy for understanding of and interest in other infectious diseases.

Zombie popularity may be a perfect opportunity to increase awareness of rabies. The most prominent resemblance between those afflicted with rabies and zombiism begins at the mouth; both ailments are primarily transmitted through biting (Table). While the pathogenesis for zombification is less consistent, rabies spreads through infected saliva entering the body (6). In addition, victims indicate infected status with increased production of fluid from the mouth; in the case of

rabies, increased salivation occurs to improve chances of transmission (6). Rabies control in practice may be similar to hypothetical control of zombie outbreaks. For example, in 2006, Chinese officials in the Yunnan province killed roughly 50,000 dogs in 5 days after an outbreak of rabies (7). This event sparked a great deal of controversy, and circumstances surrounding a similar rabies outbreak among dogs in Bali, Indonesia, in 2008 led to the primary alternative of mass vaccination. If a zombie apocalypse were to occur, surviving humans might not have the capacity for mass vaccination. The sole option may be to kill the undead for human survival; however, the ethics of destroying something that was once human might be called into question.

Additional physical characteristics of rabies and zombiism are similar (Figure). Once infected, victims display overall weakness and low-grade fever (6, 8). In the case of zombiism, the advent of fever typically indicates the transition from human into zombie. When affected by rabies, human movement is irregular; muscle spasms and convulsions accompany numbness and loss of muscle function (6). Although their physical ability varies in media, the zombies we are familiar with generally have a distinctive, hobbling gait. Rabies causes difficulty swallowing because drinking causes spasms of the voice box; zombies largely lack the ability to produce any sound other than a deep groan, although they have been capable of speaking the word "brains" in classic zombie cinema.

Shared characteristics are not limited to physical attributes. A person with rabies will experience several changes in mental state, such as increased anxiety, stress, restlessness, delirium, abnormal behavior, and even hallucinations (9, 10). Zombies will also typically display a limited level of cognitive function, with aggressive behaviors strengthening as cognitive function declines (8). However, there have been several exceptions. For example, in *I Am Legend*, the monsters were able to emulate a hunting trap made earlier by the protagonist. In the films *28 Days Later* and *28 Weeks Later*, the creatures had vastly amplified rage and slightly mitigated planning and judgment, while still mostly preserving other cognitive functions.

The numerous parallels between zombies and rabies, as well as other infectious diseases that are a threat to public health, enable the use of a popular media creature to promote the prevention and control of a public health problem. Pending specific training in public health or medicine, the layperson may gain substantial interest and understanding of rabies with our comparison and utility of zombies. In the media, protagonists always find a way to fight back against the zombies and try to maintain their survival. The attack on infectious diseases is similar to this fight against a new menace, in that new ways will be discovered along with those already known to prevent, treat, and control infections. The use of the zombie analogy can provide food for thought, thus providing inspiration for persons to be prepared for and prevent infectious disease outbreaks.

Zombie Psychology

Zombies may inspire fear within those who witness them in popular culture, and this fear can be compared with the same emotions that people might experience when they encounter the unknown. Some of the fears brought on by zombies include fear of brain dysfunction, fear of death, and feelings of hopelessness. Zombies, in turn, make these fears into something concrete, something we can reflect upon from a safe distance, as opposed to more active methods of facing our fears, such as high-risk activities like sky diving or bungee jumping. According to psychologists, watching *28 Days Later* or navigating the characters of *The Walking Dead* through Telltale Games' deadly streets can be one way in which we, as psychologically bound humans, confront our fears and attempt to prepare for the possibility of our fears becoming reality. Although we would not go so far as to suggest the beauty of our fears in the face of hope, we should at least acknowledge the positive emotional effect that consideration of past success stories when handling rabies outbreaks, and infectious diseases in general, could have on our society should a zombie apocalypse occur. After all, a progressive society cannot be built upon feelings of fear and anxiety; what better way to build feelings of hope and community than drawing similarities between a seemingly unconquerable undead foe and a similar counterpart in the history of public health that was successfully managed (to a certain extent)?

The need for psychological preparation driven by fear can be a central motivation for community action, of which public health outreach can take advantage (11). However, by using zombies in a slightly different manner, as an adaptable vehicle for instruction on prevention for rabies, and infectious diseases in general, we can introduce much of the psychology behind zombies that a blog post on disaster preparedness cannot. Much of the excitement and interest in our undead friends comes from such evaluations of shared human psyche between reality and a fictional postapocalyptic world; these may include, but are not limited to, slow degeneration of physical and mental health, ethical dilemmas, and issues of morality. For example, to generate empathy for patients having degenerative diseases, like rabies, Alzheimer's disease, or even cancer, parallels can be drawn to the sad realistic scenes of zombie films when the lone human (or zombie) survivor hangs on to dear life (or death) and sanity in the face of his encroaching demise. In addition, our former example of officials beating to death 50,000 potentially healthy dogs due to a rabies outbreak can be juxtaposed to the Kantian ethics behind killing potentially uninfected humans (for safety reasons, of course), who have just been bitten but still retain all of their cognitive functions. Even the morality of quarantining hundreds of thousands of humans citywide, sometimes even along racial and ethnic boundaries, can be more engaging when discussed within both contexts of rabies and that of zombies.

Discussion

Within the past couple of years, we have seen zombies gain traction not just in media, but also in the field of public health. Zombies entered the health circuit in mid-2011 when, after the Tohoku Earthquake in Japan in early March of that year, the Centers for Disease Control and Prevention (CDC) opened up a disaster forum on the microblogging site Twitter. In it, the CDC asked members of the general public what sorts of emergencies they were prepared for and what tactics they were using to ensure disaster preparedness. Several persons showed interest in preparing for a catastrophic zombie attack. These responses were most likely meant to be facetious, but they demonstrated the prominence of zombies in popular culture and their utility for drawing attention to health issues. As a result, Dr Ali S. Khan and his colleagues wrote a column on the Public Health Matters blog of the CDC Web site (11). They used zombies as the hook to draw readers into an article detailing how best to prepare for a zombie apocalypse and, by extension, any kind of disaster, be it natural or manmade.

The popularity of the CDC's tongue-in-cheek zombie apocalypse article prompted other organizations to create their own, shedding light not only on disaster preparedness but also the ethics of zombie killing. Among them is an op-ed piece written by Daniel O'Connor of Johns Hopkins University's Berman Institute of Bioethics (12). In the article, O'Connor outlined several bioethical guidelines to consider if one found oneself in a community that had a zombie infestation. Some of the guidelines explain the threshold at which a person can no longer be considered a human (e.g., being bitten by a zombie) and when and how to kill a zombie in a morally acceptable manner. Other guidelines underscored the importance of minimizing the risk-benefit ratio for as many people as possible when devising antizombie strategies, as well as the importance of community engagement. The most effective strategies incorporate the diverse voices of the community rather than relying solely on the judgment of the military, politicians, and health experts (13). Many of these bioethical guidelines come into play when promoting public health intervention strategies for several other diseases and health concerns, but O'Connor's article also subtly underscores the frailty of such guidelines in the face of disasters that threaten to destabilize health infrastructure. The article points toward a glaring need to ensure that the standards of public health are maintained even in the event of an apocalyptic pandemic event.

There has been speculation on whether a virus akin to rabies could become a threat similar to that of zombification. Authors of a National Geographic article titled "Zombie Virus" Possible via Rabies-Flu Hybrid? shed some light on what they believe to be an irrational fear of such a predicament (14). First, there is a mechanistic barrier to creating the perfect zombie virus from the rabies virus. Contrary to the immediate onset of zombification, the onset of rabies within the body is about 10 days to 1 year for incubation. In addition, there is a genetic barrier to induce the symptoms exhibited in zombification within the genetic code of other viruses; it is scientifically unheard of for 2 viruses to borrow traits or fuse (14). Despite the availability of cutting-edge genetic engineering that could combine the airborne potential from influenza, personality changes from measles, fever and delirium from encephalitis, and internal bleeding/necrosis from the Ebola virus with that of the rabies virus, little certainty exists that such a virus could be viable in vivo and still leave its host alive.

If a cocktail of deadly virus could not even mimic the traits of a zombie, is there any other microorganism out there that could? In fact, this answer is closer than one would expect. Simple misfolding of proteins in the brain can lead to the creation of a whole family of these anomalies, called prions. Prions can ultimately lead to brain disease, encephalopathy, which may result in personality changes, loss of cognitive function, and muscle twitching, all highly characteristic of a potential zombie. Fortunately, current scientific evidence reveals prions as incapable of causing widespread epidemics, and with an incubation period of 12-18 months before death, prions do not seem much of a threat to be compared with a zombie apocalypse.

The government might also be a barrier to a zombie outbreak, by isolating and controlling the source of such infections from circulating worldwide. Still, some may argue that governmental response to a zombie apocalypse could lead to discrimination against zombies as a minority population. We assume that much of postapocalyptic society relies on the often untrue depiction, and in some cases even satire, of nonfunctioning or ill-functioning government for entertainment value. Still, when we are dealing with disease outbreaks beyond our understanding, we must first develop a capable society that can effectively deal with outbreak control and civic problems before mentioning any possibility of a cure. For now, we can at least rest in peace without worrying that a zombie epidemic is just around the corner.

Conclusions

Zombies can be used as a powerful tool for increasing awareness of issues of public health significance. The popularity of the CDC piece on preparing for a zombie apocalypse has been instrumental in teaching how to prepare for disasters like the Tohoku Earthquake in Japan. We propose continuing these efforts, building on the popularity of zombies to increase public health awareness in the general public, and explore additional issues that may have not been considered in the past, such as infection control, mental health issues, ethics of disease, and bioterrorism potential. These issues can be explored by taking advantage of various forms of media, including 1) distributing informational pamphlets, books, and other printed media explaining the similarities between zombie infestations and lesser-known outbreaks and how to protect oneself and others; 2) creating satirical or dramatic public service announcements to promote defensive community strategies against infectious disease outbreaks by using zombiism as an analogy; 3) using interactive games, computer programs, and smartphone applications to enable the public to safely experience the natural progression of real epidemics on different levels of aggregation (e.g., individuals, communities, policymakers, medical and public health officials, both infected and uninfected), with and without intervention strategies such as vaccination, quarantine, or

extermination; and 4) and facilitating the creation of clubs, societies, blogs, and even magazine articles across age ranges, academic institutions, and internet interest groups to share the excitement of applying what we can learn about zombies to more applicable avenues of life, such as public health and epidemiology. We must also consider the possibility-no matter how remote-that zombies could very well be replaced by other popular culture icons in the future. To that end, we must continue to adapt and use these pop culture tools to increase interest in and awareness of notable public health issues affecting the world.

Acknowledgements

We thank Sandra Perez for editorial assistance and the Centers for Disease Control and Prevention for its work using zombies as a tool to increase awareness of disaster preparedness, which prompted this work.

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Table. A comparison of zombies folklore and rabies epidemiology*

Characteristics	Zombies	Rabies
Susceptibility	Human infection requires fictional apocalyptic environment	Requires environment with infected animals, such as dogs or bats
Cause	Tyrant virus, other viruses, unknown pathogens	Mononegavirales
Virus transmission	Bites and scratches; unknown pathogen; spread human to human; 100% effectiveness	Bites; saliva infected with rabies virus; spread animal to human
Virulence	Victims die and become "walking dead"	Victims die and stay dead
Symptoms	Fever, chills, loss of hair and pigmentation, hobbling gait	Delirium, anxiety, stress, hallucinations, muscle spasms, convulsions
Control methods	Avoiding bites from existing zombies; intervention includes destroying brain of zombies	Avoiding bites from dogs and bats; postexposure prophylaxis
Exposure in popular culture		
Nonscientific media	Movies, books, television shows	Movies, books, television shows
Scientific media	Zombie websites, CDC, Nature	Academic journals, global health websites, NIH, CDC, Nature

*CDC, Centers for Disease Control and Prevention; NIH, National Institutes of Health.

Figure. Comparison of physical characteristics of zombies and of an animal with rabies.

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