Ethical Resource Distribution after Biological, Chemical, or Radiological Terrorism

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Case

Twenty minutes ago, terrorists released what was probably a weaponized biological or chemical agent in a large city. Those affected seem to be within about a 12-square-block area. Despite official advice to stay calm and to avoid medical facilities unless ill or injured, the entire city panics.

On what appears to be the edge of the exposure area, the 4-year-old Smitt boy has become ill. Other family members fear that they have been exposed to the agent but are not yet showing symptoms. They all head to the hospital, afraid for their lives.

At the city's emergency departments (EDs), clinicians have realized that the symptoms seem to be cholinergic (a syndrome that produces sweating, tearing, and diarrhea and is a common effect of chemical warfare agents) and of relatively rapid onset, ruling out most biological agents as the cause. Together, the city's hospitals have enough resources to provide potentially lifesaving treatment to about 150 moderately ill or 50 seriously ill people. No one can estimate how long it will be until additional medications and equipment arrive; it will at least be many hours, or longer, if other areas have also been affected.

Patients crowd the EDs claiming to have symptoms, although many of them clearly are not (yet) ill. The Smitts demand treatment for their child and medication that is presumed to be prophylactic for themselves.

Many fire, police, and emergency medical system (EMS) personnel are requesting supplies of Mark 1 kits (nerve agent antidotes in autoinjectors), but they are in very short supply.

The hospitals' ethics committees, which have never discussed this issue, are attempting conference calls to formulate recommendations, but, with communications tied up, have not yet been able to do so.

Introduction

In situations with limited medical resources, be they personnel, equipment, or time (and it always boils down to a lack of time), clinicians use "triage" to determine which patients receive treatment. What type of treatment a patient receives depends on the triage "lottery" rules in place. Although these rules for sorting patients and distributing resources are standardized for most situations, they must be somewhat altered after overwhelming, nonstandard (i.e., biological, chemical, and radiological) disasters.

In this paper, we contrast the triage models and implementation used in routine civilian medical practice, battlefield situations, and disaster settings with those needed in biochemical terrorist attacks on civilian populations. We then describe the unique aspects of such attacks and the ethical basis for prioritizing the allocation of scarce resources to designated re-

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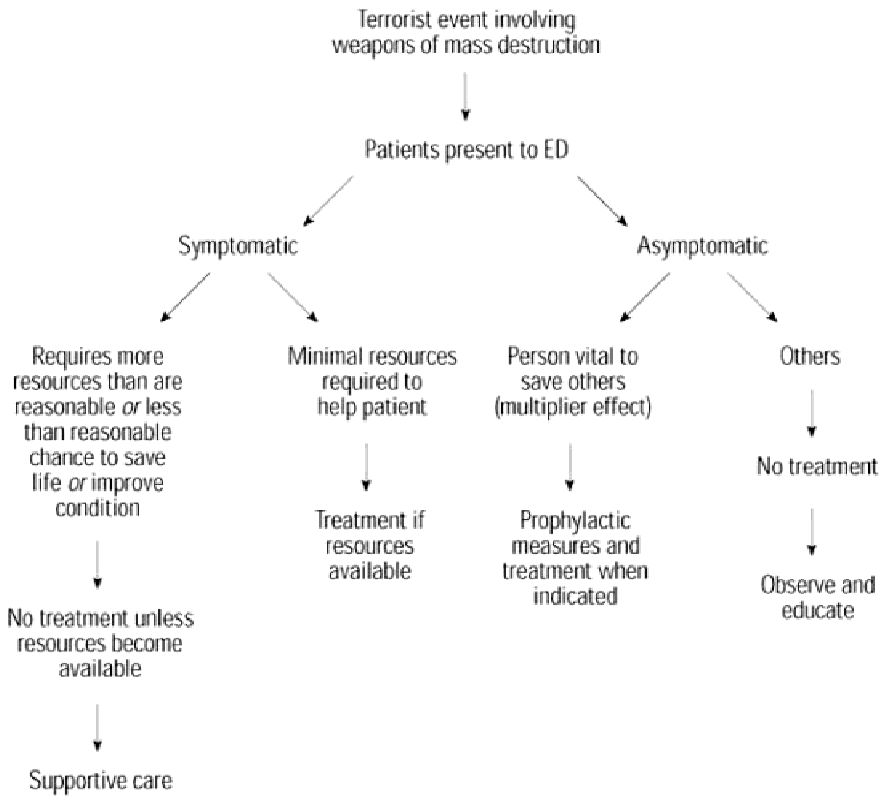

Figure 1. Postterrorist triage algorithm. (Reprinted from: Pesik N, Keim ME, Iserson KV. Terrorism and the ethics of emergency medical care. *Annals of Emergency Medicine* 2001;37(6):642–6. © 2001, with permission from Elsevier Science.)

sponders: fire, police, EMS, and, in some instances, ED personnel. Finally, we propose an algorithm to help define the process, which ethics committees—on a national and local basis—can use to develop policy *before it is needed* (see Figure 1).[1]

The Threat

Biological Agents

Biological weapons are either living organisms that can reproduce, such as bacteria and viruses, or toxic materials produced by living organisms, such as toxins and physiologically active proteins or peptides. (Few biological weapons produce skin lesions; smallpox, anthrax, and mycotoxin, which was used in Kampuchea around 1980, are the rare exceptions.) Because they must be either inhaled or ingested, biological warfare (BW) agents must be dispersed as 1 to 10-μm particles or placed in food or water.

Armies have used biological warfare for millennia. As early as the sixth century B.C., Assyrians poisoned enemy wells with rye ergot, and Solon of Athens used hellebore (skunk cabbage) to poison the water supply during his siege of Krissa. In the fifth century B.C., Scythian archers dipped their arrows in blood and manure in an attempt to make their enemies sick. The Greeks polluted their foes' drinking water with animal corpses in

300 B.C.; later, the Romans and Persians would adopt the same strategy.[2]

During the U.S. Civil War, Dr. Luke Blackburn, who would later become Kentucky's governor, tried to infect Union troops by providing them with clothing exposed to smallpox and yellow fever. (At that time, no one knew that yellow fever is transmitted only through mosquito bites.) It is not known if this plan was successful, although friends and relatives claimed that some Union officers died because of Dr. Blackburn's efforts. Confederates under Maj. Gen. Edward Johnson tried to contaminate water sources by leaving dead sheep and pigs in wells and ponds they passed while retreating in Mississippi in 1863. That same year, however, U.S. Army General Order No. 100 was issued, stating: "The use of poison in any manner, be it to poison wells, or food, or arms, is wholly excluded from modern warfare."[3]

Although BW weapons were used in World War I, both the United States and the new League of Nations, in the mid 1920s, claimed that BW was impracticable, either because of inadequate delivery systems or because of enhanced public health and preventive medicine systems. BW and chemical weapons were banned in the 1925 Geneva Protocol, which was initially signed by 28 nations. (The United States ratified it only in 1975.) The Japanese army's extensive human BW experiments during World War II and their limited use of the agents against foreign troops showed that BW agents were, indeed, practicable military (and terrorist) weapons. Based in large part on Japan's ghastly experiments, significant worldwide BW research ensued.[4]

The United States has been the target of BW agents. In 1984 the Rajneeshee cult contaminated salad bars in The Dalles, Oregon, with *Salmonella typhimurium* , which resulted in more than 750 illnesses, though initially unrecognized as BW terrorism.[5] In October 2001, the United States awoke to the danger of BW terrorism when letters tainted with anthrax spores arrived in several East-coast states, resulting in few deaths but widespread panic and antibiotic prophylaxis of thousands of individuals.

Chemical Agents

The use of chemical agents for war and terror paralleled the modern chemical industry's development. The Germans used phosgene aerosol and mustard gas during World War I, initiating widespread concern and the ultimate banning of such chemicals in warfare. Nevertheless, between World Wars I and II, two Geneva Protocol signatories, Italy (in Ethiopia) and Japan (in Manchuria and China) used chemical weapons. They were also used in the Iran-Iraq War (1980–88) and by Iraq against its northern Kurds in the 1990s. And, in 1995, more than 5,000 casualties and 12 deaths resulted when the Aum Shinrikyo cult released the nerve agent sarin into the Tokyo subway system.[6]

Radiological Agents

The use of explosives to disperse radioactive substances—weapons known as radiological dispersal devices (RDDs)—have been conceptualized for decades, but never used. There are few recorded incidents of terrorists using radioactive materials ("dirty bombs"). However, in 1995, Chechen rebels placed cesium-137 (nonexplosive) in a busy Moscow park. The radioactive material was housed in a protective canister and thus posed a limited health threat.[7] In May 2002, however, the United States captured a terrorist who was allegedly planning to build and explode an RDD within the country. As the authoritative *Jane's* reported,

> Whatever the size or overall impact of the device, however, RDDs are more a means of causing mass disruption than true weapons of mass destruction, although those disruptive effects may be considerable. The economic consequences of having an important urban area contaminated with radiation could be severe.[8]

Because of these events and the World Trade Center's destruction, the threat of domestic and international terrorism involving weapons of mass destruction has become a growing public health concern in the United States and abroad. Israel, on the front line of terrorism, has begun vaccinating certain segments of their population against smallpox. In the near future, the United States will also most likely begin vaccinating emergency responders on a voluntary basis.

In addition to these efforts, federal, state, and local agencies have begun to include comprehensive planning that focuses on state and local preparedness and response, increasing public health infrastructure and capacity, and the development of medical stockpiles. Lacking in these efforts is the development of and consensus for triage guidelines and the allocation of scarce resources in a biological, chemical, or nonnuclear radiological event resulting in mass casualties.

Triage

Clinicians have long recognized that they must have rules to equitably distribute medical resources in situations of scarcity. Triage procedures, following the concept of equity, are designed to provide equivalent treatment for those with equivalent needs—that is, to treat similar patients similarly.

Triage is always a time-limited event: eventually, no triage is necessary. However, for the period in which scarcity exists, the only option is to make difficult resource-allocation decisions. The scarcer the resources, the harder these decisions become. In civilian practice, common triage decisions involve entry priority into the emergency department and the availability of operating rooms, specialty physicians, intensive care beds, or CT scanners.

Four potential triage models are possible, based, in part, on the circumstances, or "lotteries," that govern our lives:

1. Treating the most serious, or potentially serious, illnesses and injuries first is the most common medical triage model because time, rather than actual physical resources, is what is being allocated.
2. First-come, first-served, also called the statistical lottery, is a part of normal, noncrisis medical triage. This model is unworkable in catastrophic situations because it ignores "life expectancy, urgency of need, and likelihood of survival."[9] A bias-free selection method, it would lead to gross inequities in resource distribution in these extreme scenarios.
3. Social worth as a basis for triage consideration depends on an individual's luck in the natural and social lotteries. Natural lotteries are the wide range of talents, abilities, disabilities, deformities, and illnesses among individuals. Social lotteries are the disparity in how individuals are chosen to be the recipients of attention, jobs, love, care, or other benefits. Medical triage protocols generally ignore the criteria of social worth—although individuals considered VIPs often seem to get faster, if not better, treatment.
4. Patients' best prognosis is only applied to instances of severe

resource limitation, such as battlefield and postcatastrophe triage, sometimes called "lifeboat" or "nightmare" situations. During this type of triage, clinicians decide who to save when not all can be saved. They justify this on utilitarian principles—using available resources to maximally benefit the most people.

Routine Civilian Triage

Triage in routine civilian situations, such as often occurs in EDs in the United States, treats the most urgent (or potentially most serious) cases first, followed by the less urgent cases on a first-come, first-served basis. Everyone receives necessary treatment, although those who are less ill must wait longer. As one bioethicist commented after reviewing standard medical triage,

> Insofar as the use of triage is confined to such a technical rendering of "salvageability," it seems essentially unproblematic as a model for allocating certain scarce medical services. . . . Decisions made in these contexts are not morally objectionable. They are usually made quickly and with reasonable objectivity.[10]

The criteria used in normal triage to allocate scarce medical resources include:

1. impact of treatment in improving the quality of life
2. duration of benefit
3. urgency of the patient's condition
4. amount of resources required for successful treatment
5. their likelihood of benefiting the patient.

Although, in routine triage, no one of these criteria should carry more moral or clinical weight than any other, the "likelihood of benefit" criterion is very seductive. Whether due to hubris or a sense of duty, clinicians would like to use (or, at least, claim to use) this factor over the others. There are, however, at least two serious problems with basing triage on this factor alone. First, predicting medical outcomes for individual patients is a very difficult proposition. Studies have shown that, despite other significant medical advances over the past millennia, clinicians are not very good at making accurate prognoses. Second, in some situations, the treatment will be equally effective for all patients if given early. For example, if appropriate antibiotics are given before symptoms of inhalational anthrax or pneumonic plague appear, survival is markedly increased. Following the onset of symptoms, the mortality for either disease can be as high as 90%.

Note that age, in and of itself, is not a triage criterion. However, if multiple illnesses (comorbid conditions) exist, as they frequently do in the elderly, the patient may require more resource-intensive treatment. In routine situations, this would result in their getting more urgent evaluation and treatment, but it would also mean lower prioritization in catastrophic circumstances, such as we will describe.

Battlefield Triage

Nineteenth-century armies formalized battlefield triage rules. Napoleon's surgeon developed triage procedures to help the army quickly depart the wintry Russian steppes, and medical leaders during the U.S. Civil War further refined these procedures. Aside from simply abandoning the wounded, these military physicians recognized that the options in battlefield triage are to either (1) treat those who can most quickly be returned to action with the least expenditure of time and resources, a

method the German Army successfully used during World War II; or (2) treat those who can benefit most from the limited resources available—the practice of most modern armies. Whereas many covert, guerilla, and Third World combatants are triaged via the second method, this category has become moot in some conflicts and with some modern military groups who can quickly evacuate large numbers of critically wounded combatants from the field to high-level medical facilities containing extensive resources. Such rapid evacuation of the wounded began with the basic aeromedical transport in the Korean War and progressed to helicopter transport with treatment in Vietnam. At that point, triage became a more emotionally difficult task, as medical personnel had to triage "expectant" patients, those who would probably die despite the resources that could be expended on them. (Previously, these patients rarely made it to field hospitals.) In modern military conflicts, triage often is a matter of who is evacuated to definitive care first, with the dead being the last evacuated, if possible.

Triage after Natural, Industrial, or Man-Made Disasters

The triage criteria used after such disasters depend on the anticipated numbers and extent of injuries, the geographic area involved, and the expected arrival time of additional supplies. Most commonly, these criteria involve a temporarily overwhelmed EMS system, including emergency departments and hospitals. In these instances, caregivers understand the incident's cause, can estimate the time needed for system stabilization, and know that those not initially affected, including they and their staff, will not generally be in danger. Thus, senior clinicians can strike an appropriate balance between the rules of routine civilian and those of battlefield triage, with a return to routine civilian criteria as soon as possible.

Again, social lotteries have no role in these triage decisions. As Gatter and Moskop noted,

> In disaster triage, external factors such as social status, intelligence, family, and wealth do not factor into decisions. . . . Under a triage planning concept, substantial agreement about matters such as quality of life and moral and religious values does not seem to be necessary.[11]

Triage after a Biochemical Terrorist Attack against Civilians

Triage after a suspected biological or chemical terrorist attack means that clinicians will face uncertainty about nearly all decision-important factors—except their lack of adequate resources. Initially, the causative agent and treatment will be unknown, as will be the total number of patients. In the case of a biological agent, such as smallpox, it may have been spread throughout an area as vast as the United States by the time the danger is recognized.

Triage in this setting requires a separate analysis and justification; it bears little resemblance to normal civilian triage in its ultimate purpose. Likewise, it differs from battlefield triage in that the participants neither agreed nor expected to be involved in life-threatening events. The civilian population has no training on how to react in a disciplined manner to extraordinary situations. Moreover, unlike the battlefield setting, they are rightly concerned about the attack's effect on their family and friends.

The population, predictably, will react with mass panic, given that the public greatly fears these agents and even most medical personnel have little knowledge of their effects. Although usually unwarranted, it is the effect terrorists

seek. The reality is that few biological warfare agents (notable exceptions being smallpox, pneumonic plague, and most viral hemorrhagic fever viruses) can be spread from person to person.[12] Depending on the severity of exposure to chemical agents, some individuals may require treatment, although pretreatment is generally not warranted for civilian populations.

Panic is exacerbated when it is clear that clinicians and other authorities do not know the inciting agent, the extent of the problem, whether prophylaxis is necessary, or the proper treatment. Unfortunately, the public interprets changes in information, even if it is based on progressively more accurate data, as lacking in authority, which further destabilizes the situation.

During such a catastrophic scenario, patients who constitute the "background noise" of routine ED care, such as medical patients and victims of violence (which often increases in panic situations) and other trauma, also need to fit into the triage protocol, although their treatment will probably be altered. For example, no patient will be going for a cardiac catheterization, receive CPR, or have simple lacerations repaired during such crises.

This level of triage takes experienced, strong-willed clinicians with a clear idea of what must be done, an understanding of their own and the system's limitations, and an acceptance that some people will probably die because of their decisions—whether they are correct or not. How and why these hard decisions are made should be rehearsed and discussed long before they are needed—on both a national and a local level. So far, no one has picked up this ball.

Radiological (Nonnuclear) Terrorism

Radiological (nonnuclear) weapons, officially designated as radiological dispersal devices and commonly known as "dirty bombs," are conventional explosive devices laced with radiologically active materials. Rather than being designed to cause injury, the radiological component of these devices is solely present to cause terror. Although RDDs rarely threaten the population or caregivers, except for the effects related to the explosion, they do cause widespread panic. As the U.S. Navy explained, "Misinterpretation of the explosion as a nuclear detonation may induce psychological effects similar to those produced by a true nuclear detonation."[13] Added Georgetown University (Washington, D.C.) Hospital's chief of emergency medicine, "Potentially thousands of panicked people at or near the blast site would stream into hospitals for testing, decontamination, and treatment. . . . We'll have to improvise, no matter what happens."[14]

Who Should Do the Triage?

The clinicians assigned to triage (i.e., triage officers) in disaster situations should be those who are most experienced and who are willing to make these types of difficult decisions. They become, in essence, the society's surrogate decisionmakers. This protocol is supported not only by good medical care and empirical evidence but also by the ethical stricture that, on a utilitarian basis, the most optimal use of resources will benefit the most people.[15,16] The type of individual, their professional background, and their experience will vary with the triage location, the length of time since the incident, and the population volume at the site.

On-Scene Triage

Depending on the nature of the event, EMS, fire, and police personnel will

Table 1. Standard disaster categorizations

Black	0	Expectant	No transport
Red	1	Critical	Rapid transport
Yellow	2	Serious	Transport when available
Green	3	Minimal	No transport (walking wounded)

simultaneously make initial field triage decisions. They will have a wide spectrum of clinical experience, abilities, and factual knowledge. Almost certainly, they will follow a "treat everyone unless they are clearly unsalvageable" approach; hopefully, their training has included a working knowledge of standard disaster categorizations (see Table 1). Those who are less experienced will overuse limited transportation resources, but, if an adequate communication network exists and still functions, the hierarchical fire and police organizations should quickly lead to a reasonable triage effort.

Field Triage at Treatment Stations

Basic disaster management would dictate keeping at field triage stations those patients who cannot be significantly helped by overwhelmed hospitals and EDs. Because these remote facilities are not a routine part of the medical system, establishing them will take time and, in some cases, equipment that is unavailable. If they are established in time to triage victims, very senior clinicians will need to make triage decisions at these locations. These triage officers may be relatively isolated from consultations with colleagues, and they will be the most vulnerable to coercion—and personal danger—from both the causative agent and people unhappy with their decisions.

Hospital/ED Triage

Initially, very senior clinicians—most probably, experienced emergency physicians—will be designated as the primary triage officers, deciding who gains entry to the facility and into which treatment category they fall. Security will be mandatory because these physicians will certainly be threatened because of decisions not consistent with people's expectations. Those triaged for immediate, rapid interventions will receive initial therapy in the ED. Expectant patients, those who have little or no chance of survival, will be placed in a nontreatment area where they can, if materials and personnel are available, receive comfort care.

Those triaged for surgical interventions will have a senior surgeon decide on their priority once they enter the surgical holding area. The surgeon may also specify any limitations on the procedures that can be performed or on the operating time that will be allotted. For example, a patient may be sent for a laparotomy (abdominal exploration) but with a limitation on the amount of time that may be spent before finishing or the amount of blood that may be used.

Those triaged away from the ED will be sent to a minor treatment station near the hospital, if one has been established. Unless a person's condition changes, he or she will receive care at that site and be discharged.

Should Emergency Healthcare Workers Get Priority Prophylaxis and Treatment?

Triage based on social worth, including job classification, has been rou-

tinely discounted by those establishing triage criteria because nearly any group could also be excluded by using such standards. However, prophylaxis or treatment must, in general, be provided to those who will benefit most from the least amount of resources. This includes providing prophylaxis, and treatment if it becomes necessary, to those who put themselves at risk to save lives—through direct medical interventions or by restoring order to the population. Paramedic, fire, police, and possibly ED personnel provide what has been called a "multiplier effect," markedly enhancing their worth to the community during these crises. Therefore, in catastrophic situations, those who can provide benefit to others, such as emergency workers who can rapidly be returned to their jobs (or treated so that they do not have to leave their jobs), should receive priority. Those who do not have direct patient contact, such as senior government officials (VIPs), will usually not have exposure to the inciting agent and so will need neither prophylaxis nor treatment.

Ethical Justification for Such Triage Criteria

Providing prophylaxis against a potentially lethal biological or chemical agent seems to follow from an established public health model, in which those going into contaminated areas are immunized against known diseases. A common example is prophylaxing against rabies all veterinarians and those scientists who are exposed to the virus. Such prophylaxis for smallpox is now being offered to ED and EMS personnel in consideration of their vulnerability and potential multiplier effect.

However, in the face of resource shortage, prophylaxis is not a mundane concept. The same scarce agents that can be used to treat affected people may also be the pharmaceutical needed for prophylaxis. Thus, providing prophylaxis may deny others needed treatments.

The rationale for providing this unique group with priority for prophylaxis, if clinically appropriate, follows from the concept that no one, including these public servants, is required to deliberately put their own life in danger to assist others. When they do, we call them heroes. That fire, police, EMS, and sometimes ED and other medical personnel put themselves in harm's way (e.g., when facing unknown health risks, as just after the outbreaks of AIDS, hantavirus, and SARS) is a credit to them and their professions, but, as a society, we should not rely on this unwavering dedication. The underlying ethical principle is that healthcare providers should first look to their own safety, then to that of their team's, and finally, to that of their patient.[17,18] If not given priority for treatment or prophylaxis, this group of responders may be less willing to put themselves at risk.

If a member of this group is exposed while helping others, the rationale for prioritizing their treatment stems from (1) wanting the rest of the group to feel that they will be cared for if injured, thus safeguarding team morale, and (2) a societal duty to those who voluntarily risk their lives. The first factor was the reason that ambulances initially accompanied fire departments on calls: to assist injured firemen. (The practice has, of course, evolved into our modern EMS system.) The latter factor is an obligation to those who knowingly face danger, as an EMS motto states, "So that others may live."

Treating members of these groups does have limitations. As in traditional battlefield triage, there may be those for whom treatment will expend more resources than are warranted for

a dismal prognosis. In those cases, triage officers will need their experience to exert their will and not intervene medically.

Other than providing these first responders with as many safeguards as possible, including current, reliable information, appropriate equipment, and any pharmacological protection against illness, we have little to offer those who help preserve, protect, and restore public safety and order. And what we offer may not be enough to preserve their lives and health, as was evident during and after the World Trade Center attack.

Ethics Committees' Roles

Ethics committees have, in general, shirked their responsibility to address this very uncomfortable issue. When mass casualty events such as terrorist attacks occur (and it is a question of *when*, not *if*), there will be no time to debate or to thoughtfully consider the consequences of our resource allocation decisions. As with other emergent ethical dilemmas, any changes in the normal triage protocols to allocate scarce resources must be deliberated before the event, rather than while we are in its midst.

Policy development is a recognized ethics committee function. Those committee members with, or that can obtain, the requisite expertise should assist their clinicians and their communities by helping to promote an acceptable and reasoned approach to civilian triage in nonstandard disasters. National ethics committees, such as those for surgical, emergency medicine, and first-responder organizations, have a responsibility to do likewise.

Advance bioethics planning, unfortunately, is more a concept than a reality. Often caught responding after the fact to new scientific events, the bioethics community has missed opportunities to proactively address obvious issues. Collective forethought and a broad-based consensus would go far in helping to tackle the unique moral and ethical dilemmas that will arise when a catastrophic event occurs.

Case Resolution and Algorithm

So, how would the initial case play out within our proposed algorithm? We would:

- Treat the symptomatic child, given that he requires few resources.
- Educate, rather than treat, the parents.
- Observe the family for symptoms—probably in an area distant from emergency treatment.
- Treat emergency healthcare workers who are (or will be) active in patient care if they need only minimal resources.

Eventually, enough verifiable information about the nature of the causative agent(s), the best treatment, and sufficient resources (possibly, in part, from the National Pharmaceutical Stockpile) will be available to provide prophylaxis or treatment to all in need. The triage situation will end; the repercussions will depend on how prepared we were to face it.

Notes

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