

# The Ecstasy Games: What Can the Sports Medicine Community Learn from Raves?

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## Abstract

Electronic dance music festivals, also known as raves, are increasing in popularity. Despite the occasional tragedy in the lay press regarding medical incidents at raves, such events are relatively safe when compared to other mass gatherings. While the medical usage rates are lower than rock concerts and marathons, there are many similarities to both types of events with regard to the types of injuries and medical complaints. This article may assist in planning medical support for raves in the future.

## Introduction

Electronic dance music (EDM) festivals, also known as raves, are large dance parties attended by up to 100,000 or more people. Raves frequently have elaborate light shows and visual displays that combine the feel of a carnival with loud electronic music and all-night dancing. Compared to their underground roots, raves are becoming increasingly popular and mainstream and have been associated with the use of illicit drugs. Raves have generated significant controversy due to the alleged deaths attributed to the drugs taken at the festivals (20). Little has been published in the medical literature describing the best way to provide medical care at such events. This article will describe the medical care provided at some of the largest EDM festivals in the United States, compare such medical care with other large events, and offer recommendations in planning for such an event.

## Drugs

Before discussion is undertaken on the best way to provide medical care at EDM festivals, it is beneficial for those planning medical care at an EDM festival to examine data regarding ecstasy and other drugs utilized at EDM festivals, as well as the toxicology, in greater depth.

Although methylenedioxymethamphetamine (MDMA, ecstasy, or X) is the signature drug at raves, other drugs are seen

also. In a survey, MDMA was used by 80% of ravers; amphetamine, 61%; alcohol, 24%; lysergic acid diethylamide (LSD), 42%; and ketamine, 33% (32). Other frequently encountered drugs include marijuana, phencyclidine (PCP), gamma-hydroxybutyrate (GHB), and cathinones. Although many of these drugs have identifiable toxidromes, the fact remains that multiple substances are ingested frequently. In addition, the purity of any of these drugs is suspect.

An analysis of 69 tablets marked as “ecstasy” revealed that only 30 contained MDMA with a range of 2 to 149 mg (the “normal” dose is around 90 mg). Adulterants were common in the other tablets and included other methamphetamine congeners, amphetamine, caffeine, and ephedrine. Roughly 10% of the tablets contained no active ingredient (26).

**Ecstasy** It is estimated that over 16 million Americans have used ecstasy, also known as MDMA or molly (45). The drug was used originally in some forms of psychotherapy, but no useful medical effects were documented ever. Highly charged media reports of tragic deaths in young ecstasy users have created the impression that MDMA is quite lethal. It appears however that mortality risk (as measured by HR) compared to cocaine and heroin is actually low for drugs in this class (28). Others have disputed the notion that MDMA is relatively nontoxic, however (11). What is not in dispute is that MDMA can be quite toxic, and this seems to be idiosyncratic with lethal levels and “therapeutic or desired effect” levels having significant overlap (25).

Ecstasy is a sympathomimetic that has serotonergic and noradrenergic effects and produces effects similar to amphetamine and mescaline. Ecstasy temporarily inhibits the reuptake of serotonin and dopamine, and users experience intense feelings of sensory pleasure, closeness, and happiness (33). The music, dancing, and light shows, commonly seen at EDM festivals, maximize the sensory stimulation. Due to feelings of emotional intimacy, fighting and aggression among ecstasy users are rare at these events.

Mild adverse effects include bruxism, nystagmus, mydriasis, hyponatremia, blurred vision, muscle spasms, nausea,

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and vomiting. Major effects include tachycardia, hypertension, seizures, disseminated intravascular coagulopathy, intracranial hemorrhage, hyponatremia, rhabdomyolysis, and hyperthermia (9). More ominously, some participants have presented with chest pain, cardiac arrest, or even death (35).

Hyperthermia can be exacerbated by ambient temperature, humidity, and excessive dancing. One overdose patient survived with a temperature of 109.2°F (22). There are also chronic effects seen in MDMA users. Permanent neurobehavioral and neurocognitive deficits have been reported even after a single use of the drug (35). In addition, due to monoaminergic depletion, many users report feelings of depression and negative moods after ecstasy use (34).

Hyponatremia is listed as both a mild and a major effect. Most cases are asymptomatic (it may be present in up to 25%–38% of users) but also are felt to contribute to seizures and cerebral edema. Hyponatremia is more common in women (43) and seems to be related to MDMA-induced secretion of vasopressin and subsequent water intake (39).

Treatment of overdose may include hydration, cooling measures, saline infusion, as well as administration of lorazepam or midazolam. The dosage of benzodiazepines administered varies per patient but can be considerable, depending on the symptoms. Despite large doses of benzodiazepines to counteract symptoms, most patients recover quickly and are able to be discharged home.

**Other drugs** Although not as pervasive as ecstasy, other drugs also can cause problems for rave attendees. Amphetamine overdose can be treated similarly to ecstasy with lorazepam or midazolam to blunt the adrenergic effects. Cathinones have become popular in recent years and are sometimes marketed as “bath salts”. As with other illicit drugs, purity is suspect and adverse reactions are common. Treatment is similar to that for amphetamine and ecstasy. LSD also can be treated with supportive measures; often simply reducing sensory stimulation in a quiet, darkened room is all that is required.

PCP is a dissociative agent-like ketamine, but unlike ketamine, it can produce wildly aggressive, belligerent, and psychotic behavior. These patients may require both physical and chemical restraint. Alcohol, which is increasingly common as raves become more mainstream, is known also to cause behavioral problems similar to PCP. Vomiting and somnolence can create difficult airway issues. Occasionally, especially in younger patients, alcohol can cause profound hypoglycemia. Surveillance of these patients in the care center is critical. GHB deserves special mention. It is a potent CNS depressant and can create apnea, nausea, and vomiting, a combination that can have lethal effects. In this respect, the adverse effects are similar to alcohol. The difference is that the half-life of GHB is approximately 30 min, so these patients tend to recover quickly.

### Goals and Medical Action Plan

EDM festivals range from several thousand to over 100,000 attendees. This section will focus primarily on describing a plan for moderate to large music festivals with approximately 25,000–100,000 attendees but can be scaled up or down as needed. Examples of such EDM festivals, where care has been provided by the authors, include the

following: Escape from Wonderland (50,000 attendees), Nocturnal (50,000 attendees), Coachella Music Festival (90,000 attendees), Together As One (40,000 attendees), White Wonderland (15,000 attendees), LA Hard Summer (50,000 attendees), Day of the Dead (50,000 attendees), and Escape from Wonderland and Electric Daisy Carnival (100,000 daily). The following venues have been used: Los Angeles Coliseum, Staples Center, Nokia Center, National Orange Show, Las Vegas Motor Speedway, Indio Polo Fields, Shoreline Amphitheater, Los Angeles Historic State Park, the Hollywood Palladium, and many others.

Similar to other large events, the goals of medical support at large EDM events include the following:

1. Provide basic first aid to promote an enjoyable atmosphere and prevent minor problems from becoming more serious;
2. Provide advanced medical services to promote rapid and safe transfer of critical patients to appropriate local hospitals;
3. Minimize the impact on the local 911 system and hospitals by preventing unnecessary ambulance transports;
4. Avoid impacting the local 911 system and hospitals in a way that dilutes its ability to respond to citizens of the local community or to provide backup to the event in case of a major incident.

There may be significant variation in the specific approaches to EMS delivery at large events; however according to the National Association of EMS Physicians (19), each mass gathering should have a blueprint for the delivery of emergency medical care known as the medical action plan. The medical action plan should address the following components: medical oversight, medical reconnaissance, negotiations for event medical services, level of care, human resources, medical equipment, treatment facilities, transportation resources, public health elements, access to care, emergency medical operations, communications, command and control, documentation, and continuous quality improvement.

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### Medical Oversight

The level of medical care at large EDM music festivals is generally three tiered. First, patients with minor complaints and/or basic first-aid requests (band-aids, earplugs, sunscreen etc.) are cared for by one of the various mobile response teams or at any of the first-aid stations. These first-aid stations and mobile response teams are composed mostly of basic life support (BLS) personnel.

Second, patients with mild to moderate injuries (dehydration, intoxication, OTC medications, etc.) will be cared for at the care center. The care center is staffed with physicians and nurses. In general, there is only one care center at such events; however, there may be anywhere from one to four or more basic first-aid stations depending on the size and layout of the specific event.

Finally patients with severe injuries or illness are transported to the care center for stabilization or directly to an off-site hospital as medically appropriate. Medical personnel caring for these patients should be certified at the advanced life support (ALS) or higher level of care and familiar with the local EMS system.

Since one of the goals of medical support at raves is to minimize the impact on the local 911 system and on-site physicians have been shown to reduce ambulance transports from large mass gatherings (13), it is strongly recommended that an on-site board-certified emergency physician with significant prehospital experience be designated for overall medical oversight.

### Medical Reconnaissance

Medical reconnaissance is an evaluation of the elements that affect the numbers and types of patients expected at a particular event for planning purposes. The key factors to consider are the following: venue location; type of event; duration of event; expected attendance; available medical resources; available local hospitals and EMS providers; crowd demographics; expected weather conditions; risk of violence; risk of alcohol and drug use; physical barriers to access patients; entrance and exit locations; and availability of food, water, and shelter. Prior to the event, the medical director for any music festival should visit the venue and review any information from prior similar events in order to ensure adequate medical resources.

### Negotiations for Event Medical Services

Negotiations to provide medical support for a large music festival should be completed long before the event takes place. Liability coverage and compensation are two areas that typically require the most discussion. While EMS personnel frequently believe more is always better, this is not necessarily true. The significant expense to the promoter of providing adequate medical care for the event should be taken also into consideration. Ultimately the negotiations should be based on medical support for the reasonably likely scenarios following adequate medical reconnaissance rather than the “just in case” or “worst case scenario” mentality those in EMS typically observe. It is important to remember that contracting for medical services should be a “win-win” for both the promoter and your medical team.

Although political considerations may require otherwise, the fewer the number of organizations involved in the actual medical care, the more efficient and cost effective it becomes. Although the local fire department, local ambulance provider, public health department, local hospitals, and others need to be involved in the planning process, they do not all need to be involved in on-site medical care. In fact, many experts recommend utilizing private companies with strong medical oversight that specialize in providing

medical support as both the most cost effective and medically appropriate approach to negotiating medical support for such events.

### Level of Care

While most care provided at large mass gatherings is limited to BLS, a significant number of patients at any large mass gathering will likely require ALS or higher level of care such as that provided by critical care transport (CCT) nurses, physician assistants, or physicians (12).

Based on our experience, most EDM events require care for approximately 25 patients per 10,000 (PPTT) attendees. For planning purposes, the authors recommend staffing to take care of 25 to 50 PPTT. Due to the nature of such events and the risk of severe dehydration and overdoses that may involve airway issues, a significant number of the personnel should be ALS certified or higher. Some of the more common presenting complaints involve dehydration, alcohol intoxication, and drug ingestion; therefore one should plan for a longer treatment/observation time than that required at some types of events.

While the goal of reducing unnecessary ambulance transports is important for the local EMS system, it is also vital that the level of care provided to the patients with alcohol intoxication or drug overdoses maintains a similar standard of care to that of an emergency department. It is recommended that the nurse-staffing ratio generally should not exceed four patients per nurse for anyone with more than minor injuries or illness. It will be necessary also at the larger events to schedule a charge nurse to assist with the triage and care of patients that are more complex.

Unlike rock concerts (14,18,27), rave patients do not usually present with significant trauma. Most traumas are minor and related to dancing such as twisted ankles, abrasions, and minor lacerations. Thus imaging modalities such as x-rays, ultrasound, or computed tomography scanners are unnecessary. The rare patient that requires such level of care is transported to the closest appropriate emergency department for definitive care. On the other hand, use of an iStat or a similar device can be beneficial due to the increased incidence of hyponatremia associated with extreme lengths of dancing and possible illicit drug use.

### Human Resources

Although every event and venue is unique, staffing of medical personnel for large EDM music festivals should be similar to that for other large events. Table 1 outlines **T1**

**Table 1.**  
Recommended staffing levels for a typical EDM event with attendance 10,000–100,000 +.

Care center	No.	Mobile Teams	No.
Physician(s)	1 per 20,000	EMT teams	1–3 per 5,000
Critical care nurses	1 per 5,000	Supervisor(s)	1 per 20,000
EMTs	1 per 5,000	Miniambulances	1–2 per 20,000
Supervisor	1 per 20,000		
First-aid station(s)	1 per 20,000	Dispatcher(s)	1–2
Basic EMTs	1–3 per station	ALS/CCT ambulances	1–2 per 10,000



generally recommended staffing based on the number of participants expected.

### Treatment Facilities

In order to achieve the above goals, we typically staff a care center with emergency physician(s) and critical care or emergency nurses. The patients with dehydration, intoxication, drug ingestions, and/or other minor to moderate illnesses will be primarily cared for in the care center. In addition to the care center, one to four or more first-aid stations are typically staffed with BLS personnel spread throughout the venue. Any patients requiring ALS level of care such as IV fluids, advanced airway procedures, suturing, etc. are transported to the care center and evaluated by a physician.

The care center and first-aid stations are typically tents of varying sizes depending on the event. The first-aid stations are usually about 20 × 20 ft while the care centers range from 20 × 40 up to 40 × 120 ft or even bigger. The care center is divided typically into private rooms, a breathing treatment area, a supply room, a nursing station, a waiting area, and a reception desk area. Dedicated restrooms are also available for patients. Pictures of a typical care center are shown in Figures 1 and 2.

F1 F2

Similar to medical support at other mass gatherings and sporting events, an on-site care center can prevent the vast majority of patient transports (12,13).

### Transportation Resources

The appropriate number of miniambulances for on-site transport and standard ambulances for off-site transports will vary with the size of the venue, number of attendees, distance to local hospital, and level of care provided on site.

Miniambulances staffed with ALS personnel should be available to respond in crowded areas and begin emergency care immediately. As previously mentioned, EDM events tend to have little trauma; however it is important to ensure that the miniambulances are able to transport a patient in full spinal immobilization with ALS personnel able to secure an airway and treat seizures.



**Figure 1:** Symons Ambulance medical tent ("care center") at Shoreline Amphitheatre for Beyond Wonderland.



**Figure 2:** Interior view of private rooms in care center at rave.

Full-sized ambulances staffed with ALS or higher level personnel should be staged near the care center with established egress routes. Although few patients require ambulance transport to the hospital when an appropriately staffed and equipped care center is available, certain patients belong in a hospital. Examples of such patients include any patients with chest pain concerned for cardiac ischemia and new-onset seizures with an altered mental status and hyperthermic patients (Figs. 3–5).

F3 – F5

### Command and Control

Every large event should have a clear organizational structure that delineates responsibility and authority for the provision of medical services. The integration of medical oversight into the overall administrative structure of the event is also essential. For large mass gatherings, most experts recommend using the incident command system with a centralized command post. When the event includes multiple public safety services or EMS agencies, the unified command model should be invoked. The location of the command post should be marked clearly, and all event personnel should know its radio identifiers and telephone numbers.

On-site medical responses should be dispatched via a single radio frequency/channel by a dedicated dispatcher. It



**Figure 3:** Miniambulance for on-site transportation.



**Figure 4:** Miniambulance transporting patient at event.

is important to note that telephone service has failed at many of our larger events due to the overwhelming number of attempted cell calls from participants thus preventing telephone service from being dependable for emergency service use. Therefore it is imperative that an alternate source of telecommunication be readily available.

#### Equipment and Supplies

Medical support for large EDM festivals should include, at a minimum, all equipment, medications, and supplies necessary for an ALS or higher level of response.

Additional equipment that is especially helpful beyond the usual first aid or ALS scope of practice includes the following:

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RSI medications (succinylcholine, etomidate), benzodiazepines, ondansetron, phenergan, haloperidol, iStat with chem 7 cartridges, ophthalmoscope, fluorescein, blue light, nasal rockets, suture supplies, dermabond, tetanus, ring cutters, and 12-lead electrocardiography capability.

#### Public Health Elements

The public health component of a medical action plan includes protecting the health and well being of staff and



**Figure 5:** Symons Ambulance units staged in front of a 20-bed care center at Beyond Wonderland in San Bernardino.



**Figure 6:** Event signage.

spectators from infections and injuries related to improper food, water, waste, land, and traffic/road management. Although most of these issues are overseen by other entities, the medical director should have a working knowledge of any potential concerns.

Preventive medicine issues should be addressed in this part of the plan. Potential problems at EDM festivals can include the following: security search of guests for drugs at entryway, safety barriers near pyrotechnics, misters and shade at venues with high temperatures, adequate portable toilets, adequate drinking water, and planning taxi/transportation service for intoxicated guests at the end of the event.

#### Access to Care

Although appropriate medical staffing at large music festivals is important, none of it matters if patients are unable to access the care when needed. Thus it is important



**Figure 7:** Event signage.





**Figure 8:** Mobile EMT teams.

that both staff and participants be educated regarding how to access the medical system. Examples of appropriate signage at such events are included in Figures 6 and 7. Notice that the sign on the left at Electric Daisy Carnival includes directional signage for both medical care and for those just looking for water. The large first-aid banners in the picture on the right also light up at night and can be seen throughout the venue after the sun goes down. It is also imperative that mobile EMT teams and miniambulances are easily identifiable for those requiring emergency medical assistance. Standard uniforms and emergency lighting as pictured in Figures 8 and 9 can assist patients accessing or flagging down appropriate medical resources.



**Figure 9:** Mobile miniambulances.

## Documentation

All patient contacts should be documented on a standard medical record. Patients requiring only basic first aid are typically recorded on a standard log. However any patient contacts more serious in nature or likely to have associated liability are routinely charted on a standard “prehospital patient care record”.

## Continuous Quality Improvement

A basic CQI plan should exist for every large music festival. The plan should address how medical care at one event will improve care at future similar events.

## Discussion — Compare and Contrast with Other Events

The medical usage rate at large events is reported most commonly either as a percentage or as PPTT attendees. Examples of medical usage rates for various types of events are listed in Tables 2 and 3. Based on the reported data in the medical literature, raves appear to have a lower medical usage rate than numerous reported rock concerts, major motorsports events, or marathons but a higher usage rate than college football or fairs. Raves appear to have medical usage rates most similar to major sporting events such as the Olympics.

Medical support for raves tends to be surprisingly akin to medical support for a cross between a rock concert and a marathon with regard to the types of injury/illness seen. The lower medical usage rates at raves may be related to the

**Table 2.**

**PPTT reported at large events.**

Event	PPTT	Reference
Ski marathon	441	8
Marathon	228	29
Twin City marathons, 1983–1994	189	37
Woodstock, 1969	125	5
Baltimore Marathon, 2002–2005	107	41
Royal Adelaide Show, 1991	91	7
Rock concerts	83	20
Glastonbury, 1971	77	3
Vermont Rock Festival, 1973	69	30
U.S. Festival, 1982	64	31
Rolling Stones concert, 1972	50	16
Summer Olympics, 2008	44	46
NASCAR race, 1997	43	13
Winter Olympics, 2002	26.9	1
Winter Olympics, 1988	19	42
Papal visit, 1995	19	6
Summer Olympics, 1984	16	2
College football season, 1995	11	38
Winter Olympics, 2006	12.7	36
New York State Fair, 2004–2008	4.8	15

**Table 3.**  
PPTT at large EDM festivals (24)

Event	PPTT
Electric Daisy Carnival, 2010	21.6
Love Festival, 2010	22.8
Monster Massive, 2010	16.8
Together as One, 2010	13.7

generally young and healthy patient population that attends such events.

The most common types of injuries at marathons involve musculoskeletal, dehydration, and dermal injuries (31). Not surprisingly, raves tend to have similar types of patient complaints due to the numerous hours spent dancing. In addition to the above, raves tend to have numerous patients with alcohol intoxication and/or possible drug ingestions similar to what is seen at rock concerts.

Numerous authors have described alcohol and drug use at rock concerts for decades with usage rates between 8% and 14% (3,4,17,32). The concern for alcohol and drug use is not limited to rock concerts, however. For instance, cocaine use was associated with jazz in the 1920s to 1930s, while “beatnik” folk music of the 1960s was associated with hallucinogens (21). Throughout the 1970s, rock concerts were associated with the use of LSD and other drugs.

To provide supportive care until the alcohol or drugs wore off, many authors from the 1970s report utilizing a van as a “drug overdose unit” (32) or “a bad trip tent” (3). This approach continues to be used at many large music festivals today and is akin to the approach described in this report. In the past, this approach was not utilized at certain events and created significant impact on the surrounding EMS system and community by overwhelming resources. Thus utilization of an on-site care center staffed with qualified emergency physicians and critical care nurses is recommended strongly.

After providing care at numerous large raves, the authors have noticed the vast majority of the more serious patients present in the final few hours of the event. The friends of the patients frequently report the patient was dancing for hours and then suddenly seemed to “hit the wall” and was exhausted completely.

It is interesting to note that most marathon runners are reported to seek care either at or near the finish line. This has been thought to be due to the runner’s strong desire to finish the race and frequently ignoring their symptoms until the race is over (23). It is also interesting to note that “runners’ high” has been reported (40) in marathon runners. They report cognitive dissociation, whereby they cut themselves off from the sensory feedback they would normally receive from their body. “Hitting the wall” is a point of maximum fatigue that occurs around the 20-mile mark, when runners’ carbohydrate reserves are depleted and their bodies switch to metabolism of fat for energy.

### Regulating Raves

Due to the increasing interest in rave culture and the “threat” of ecstasy, politicians have become more involved

in the regulation of such events in their jurisdictions. Glover (10) points out that politicians and municipal officials have three strategies to deal with raves.

**Tolerance** If government entities ignore raves, they will become mainstream and in so doing lose their popularity since the ravers claim to despise mass-produced, commercialized goods and events. Obviously this is not an appealing option for most politicians who want to be seen as being proactive.

**Prohibition** Develop laws against sale and usage of ecstasy that will send a clear message because of the punitive consequences. However nonviolent drug offenders make up over half of the federal prison population at a time when the United States is the largest jailer in the world and trying to decrease its prison population. Some argue that as raves are driven underground by increased police presence, there is added danger associated with acquiring these drugs and increased risk of death due to lack of appropriate medical care.

**Harm reduction** A progressive alternative is for the government to adopt harm reduction strategies. These might include encouraging abstinence and providing education about the health effects of these drugs. The other aspect of harm reduction is to provide those that do take drugs the resources they need to minimize harm to themselves and others. Venues should be safe with adequate security, fire, and medical services. This would include adequate water, shade, and shelter.

Others (44) offer more specific harm reduction strategies, ideally distributed to attendees before the event:

1. Water and sodium salt replenishment
2. Dancing breaks
3. Understanding the risk of adulterated or impure drugs
4. Avoidance of alcohol
5. Avoidance of coingestion of more than one drug
6. Ensure that a medical team is on the premises
7. Attend the rave with someone else (the buddy system)

Since it is unlikely that any measure will successfully prevent everyone from using alcohol or illicit drugs, the authors recommend a pragmatic approach of harm reduction that includes strong medical support of such events.

### Summary

Despite the occasional tragedy and sensationalized story in the lay press regarding medical incidents at “raves”, raves are relatively safe when compared to other large mass gatherings such as rock concerts and marathons. While the medical usage rate at large EDM festivals is less than that of rock concerts or marathons, there are many similarities to such events related to the types of complaints. The above-described medical action plan may assist in planning of medical support for EDM festivals in the future.

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