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Characteristics, presentation and outcomes of music festival patrons with stimulant drug-induced serotonin toxicity

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LFM reports no relevant conflicts of interest

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Abstract

Background

A large number of stimulant drug-associated deaths at music festivals in Australia were reported during the southern hemisphere summer of 2018 – 19. This led to the prehospital deployment of health-care professional led critical care response teams. We aimed to describe the characteristics, clinical presentation, management, and outcomes of music festival patrons with stimulant drug-induced serotonin toxicity managed using this model during the study period.

Methods

We performed a retrospective observational study of patients presenting with stimulant drug-induced serotonin toxicity and/or drug-induced hyperthermia who presented between December 2017 and December 2019. Comprehensive follow-up data was collected for those patients who required hospital admission. Data included demographics, clinical features, management and disposition, hospital outcomes and laboratory data, stratified by severity of presentation.

Results

47 patients were included. Median age was 21.9 years (IQR 19.6 – 22.2). MDMA was the most frequently reported agent ingested (32/47). After stratification, 13/47 were classified as mild, 20/47 as moderate, and 14/47 as severe. Median presenting temperature in this cohort was 41.1°C (40.5 – 42.0°C). All severely ill patients required ICU admission, with a median hospital stay of 4.63 days (IQR 2.08 – 8.36). End organ complications were reported in 11/14

patients. No mortalities were reported. All patients (13/13) from the mild cohort and 15/20 patients from the moderate cohort were treated and discharged on-site.

Conclusions

Severe illness was associated with a high incidence of end-organ impairment. A high proportion of patients without severe disease were able to be successfully managed at the event without transport to hospital. No deaths are reported in this series.

Introduction

Australia has seen an increase in deaths associated with stimulant drug use by music festival patrons, culminating in a cluster of mortalities between December 2017 and January 2019. These events were predominantly due to 3,4-methylenedioxymetamphetamine (MDMA) ingestion, in isolation or in combination with other stimulant drugs (1). Unintentional stimulant-related deaths in Victoria and NSW increased from less than one death per 100,000 population per annum in 2001, to 2 – 3 deaths per 100,000 population per annum in 2016 (2). Drivers for these trends have been described (2–5).

Serotonin toxicity is characterised by the triad of altered mental status, neuromuscular excitation and autonomic dysfunction (6). Hyperthermia is the most life-threatening manifestation. Degree and duration of temperature elevation correlate with mortality (7,8). Survivors of stimulant drug-induced extreme hyperthermia (presenting temperature > 42.0°C) are rare (5,9).

Independent health care professional-led critical care teams are deployed to music festivals to facilitate the early recognition and management of serotonin toxicity and improve health outcomes (10–12). While the general use of these teams at music festivals and endurance exercise events has been previously reported in the literature (13,14), specific data from these teams examining stimulant drug-induced treatment outcomes, morbidity and mortality have not. The prognosis of stimulant drug-induced hyperthermia is poorly characterised, with the existing literature being limited to individual cases, or small case series (5,10,15,16). We undertook a study of music festival patrons presenting with serotonin toxicity and/or stimulant

drug-induced hyperthermia. We aimed to describe the clinical course and prognosis of affected patients over the study period.

Methods

Model of care and study setting

Patients were treated by a Medical Assistance Team (MAT) or a Health Emergency Response Team. A MAT is a temporary field hospital, staffed with medical practitioners, nurses, paramedics and logistical staff, which can be employed to provide care at high-risk mass gatherings such as electronic dance music festivals. Depending on the size of the event, each MAT is staffed by at least one independent medical practitioner (who is generally a specialist anaesthetist, intensivist or emergency physician or of senior registrar grade in these specialties), and is capable of performing rapid sequence intubation, mechanical ventilation, external cooling and point-of-care biochemical analysis. A HERT is a smaller, more mobile critical care response team. It is staffed by two or three health care professionals (one of whom must be able to practice independently; that is, a paramedic or a medical practitioner). The level of care able to be provided by the HERT is determined by the scope of practice of the independent practitioner leading the team.

The two objectives for the delivery of care using these models are:

1. Provide definitive treatment on-site where possible, minimising the burden on health system resources; and,
2. For those patients in whom hospital transport is required, provide high-quality critical care in the field to minimise subsequent morbidity and mortality.

Study design

We performed a retrospective observational study of all music festival patrons with stimulant drug-induced serotonin toxicity that were managed between December 2017 and December 2019, and linked presentations to hospital outcome data where possible. Ethics approval with a waiver of informed consent was granted by the Austin Health Human Research Ethics Committee (LNR 50320/2019).

Prehospital case definition and data collection

Inclusion criteria were defined *a priori*. Music festival patrons were included if they presented with hyperthermia (defined as a tympanic temperature ≥ 38°C) and/or serotonin toxicity as defined by the Hunter Serotonin Toxicity Criteria (Figure 1) (17). Patients judged to have a non-pharmacologically mediated cause for hyperthermia (i.e., sepsis), or significant confounding pathologies were excluded. Illness severity was defined as:

- Mild; temperature throughout prehospital management < 38°C, no requirement for prehospital intubation.
- Moderate; temperature at any point during prehospital management 38.0 – 39.9°C, no requirement for prehospital intubation.
- Severe; temperature at any point during prehospital management ≥ 40°C or requirement for prehospital intubation.

We collected demographic data, including age, sex, past medical history, regular medications, and drug exposure history. Whilst ethnicity was not recorded as a prehospital data point, this information was sourced from hospital records for patients who required ambulance transfer. Prehospital clinical presentation data included triage vital signs (heart rate, systolic blood pressure, respiratory rate, peripheral oxygen saturations and tympanic temperature) and

significant clinical findings (hypertonia, hyperreflexia, clonus and Glasgow Coma Score [GCS]). Prehospital management data included requirement for, and doses of benzodiazepine, requirement for anti-serotonergic therapy (principally chlorpromazine), requirement for and volume of intravenous fluid, and requirement and reason for pre-hospital intubation. Discharge disposition data included length of MAT stay, vital signs at time of discharge (heart rate and tympanic temperature), and requirement for hospital transport.

Hospital data collection

Data for patients transported to the health services that participated in the study were sourced from the medical record. Emergency Department (ED) data included requirement for ED intubation, and requirement for additional treatment modalities such as extended neuromuscular blockade, invasive cooling and Intensive Care Unit (ICU) admission. Hospital outcome data included length of ICU stay, length of hospital stay, requirement for renal replacement therapy, major end-organ complication (disseminated intravascular coagulation, acute kidney injury, acute liver failure, cardiac arrhythmia [defined as atrial fibrillation, atrial flutter, supraventricular tachycardia, ventricular tachycardia or ventricular fibrillation], myocardial injury [defined by serum troponin I elevation or reduced ejection fraction on echocardiography], acute respiratory distress syndrome, delirium or permanent neurological injury); and mortality. Additional laboratory data for patients requiring hospital admission examining laboratory markers of end-organ dysfunction were extracted (peak lactate, potassium, creatinine kinase, troponin I, urea, creatinine, prothrombin time and alanine aminotransferase, and nadir sodium and albumin).

Statistical analyses

Results are reported as per the Strengthening the Reporting of Observational Studies in Epidemiology guidelines (18). Categorical data are reported as proportion, and continuous data as mean (SD) or median (IQR) depending on normality. Fisher's exact test was used to compare categorical data. Continuous data were compared using unpaired Student's t-tests for normally distributed data and the Kruskall-Wallis test for those not normally distributed. Prehospital data was stratified and presented according to severity. Analyses were performed using XLSTAT (Addinsoft, New York, NY).

Results

Characteristics of included patients

A total of 5266 prehospital patient presentations (incorporating 646 drug-related presentations) from 73 mass gatherings were screened; 51 records (1.4%) met inclusion criteria. Two records were discovered to be duplicates and excluded. Two patients were excluded due to confounding medical conditions (one urinary tract infection and one other). We are unable to provide more details on this latter case due to the risk of inadvertent patient re-identification. Records from 47 patients were included in the analysis (Figure 2). There were 35 datum points missing from the final analysis cohort from a possible 2767, representing 1.25% of all possible data; these predominately related to laboratory markers of end organ function for patients admitted to hospital who did not undergo these investigations. Full details about the events screened including type of venue, location, type of presentations and contribution to the final data set are contained in Appendix 1.

Prehospital clinical assessment and demographics

The median age of the included population was 21.9 years (IQR 19.6 – 22.2 years). The majority were male (32/47). Seven patients had a relevant past medical history and 3 were taking relevant regular medications. MDMA was the most commonly reported agent ingested (Table 1). Multiple drug ingestion was reported in 55% of the population, although severe illness was more frequently associated with reported consumption of a single agent. Neuromuscular features of serotonin syndrome (clonus, rigidity and hyperreflexia) were reported in all categories; severe illness was associated with a higher incidence of altered conscious state and lower GCS relative to other groups, and also associated with worsening physiological parameters, with statistically significant associations between this group and higher heart rate and respiratory rate, and lower systolic blood pressure and peripheral oxygen saturation. A higher incidence of arrhythmia was seen in this group, as was the single cardiac arrest for the cohort.

Prehospital treatment and disposition

Some 89% of patients received benzodiazepine therapy; those with mild illness were more likely to receive oral benzodiazepine therapy (Table 2). All 14 patients with severe illness required transport to hospital, and all required intubation, either prehospital [10/14] or shortly after ED arrival [4/14]). The decision to transport was made early, with patients in the severe illness category having a length of stay 50% shorter than patients with mild or moderate disease. A clinically significant reduction in temperature was seen in the moderate and severe groups for which in-hospital follow-up data was available with the institution of prehospital therapy. While the median temperature in the severe group remained ≥ 40°C at time of departure from the venue, by the time of arrival in ED (median transport time 76 minutes [42 – 117 minutes]), the median temperature of this cohort had reduced to 37.4°C. Generally, patients with mild and moderate drug-induced serotonin toxicity were managed effectively on-

site, with 28 of 33 patients discharged back to the event or home. All non-severe patients requiring transport were classified as moderate. There were varying reasons for hospital transport in this cohort, with patients often having more than one indication. Reasons for transport in this cohort included temperature control [1/5], altered conscious state [2/5], resource or capacity issues including the end of the event [3/5], and other [3/5].

In-hospital data and outcomes

We report no mortalities, despite including six patients with a presenting temperature of > 41.5°C. All patients with severe illness were hospitalised, and all required admission to ICU (Table 3). The median length of ICU stay was 1 day, with a median duration of mechanical ventilation (including prehospital, ED and ICU care) of 17.15 hours. Some 79% of the severe group sustained end-organ impairment. These included biochemical evidence of myocardial insult, acute kidney injury, transaminitis and rhabdomyolysis (Table 4). One patient remained dialysis-dependent at time of hospital discharge. A further participant required a 101-day ICU stay and sustained a permanent neurological injury. Patients with moderate illness that required hospital transport were all able to be discharged home directly from ED without end-organ impairment or hospital admission.

Patients of Asian extraction made up the majority of patients requiring hospital transport, with patients of Caucasian extraction accounting for the remainder. Ten of the 14 patients with severe illness were of Asian extraction. Additionally, men were also overrepresented, with only one woman in the severe sub-group. However, this result was not statistically significant when compared to the representation of men in the mild and moderate sub-groups ($p = 0.059$).

Discussion

We have reported a retrospective case series of Victorian music festival patrons with stimulant drug-induced serotonin toxicity, all of whom were managed in the prehospital environment and some of whom who received prehospital critical care. A high proportion of patients were able to be successfully treated on site, and no deaths were reported in the most severely ill patients in our series. Additionally, in patients with severe illness, drug-induced serotonin toxicity is associated with high incidence of end-organ dysfunction. Finally, our results show an unexpectedly high representation of Asian patients, and male patients in the group that experienced severe disease. However, due to the relatively small numbers we are unable to draw any conclusions from this observed association due to uncertainty.

Our study has several strengths. It is the first case series that reports delivery of prehospital critical care for the management of drug-induced serotonin toxicity, and the first to link prehospital and in-hospital data across multiple different health services. It is the largest single case series of drug-induced serotonin toxicity to date.

It is important to comment on the historical context of this case series. Over the course of the study period, a number of cases of severe stimulant drug associated serotonin toxicity were reported in Australia (1). This cluster was remarkable for the frequency and severity of the associated presentations, particularly over the southern hemisphere summer of 2018 – 2019. Wastewater analysis from South Australia during this time noted a 200% increase in MDMA use relative to the yearly average (19).

Our direct presence at several music festivals at which cases were recorded during this time provided an opportunity for us to report the patterns of presentation and treatment of a relatively large prehospital cohort of affected patients. MDMA was reported as having been consumed in 80% of all presentations, and 78.5% of severe presentations. One particular point of interest in our reported results is the usually low incidence of multiple drug ingestion, demonstrated in only 21.4% of patients with severe serotonin toxicity. Such a finding is consistent with other series that have examined this cluster. The toxicological analysis of a smaller NSW population taken during the 2018 – 19 festival season have previously been reported by Black et al (20). Similar to our data, the authors found MDMA to be the primary agent ingested, detected in 87.5% of individual samples. While ketamine was detected in 52.5% of samples in this series, the investigators were able to confirm in all but two cases that this was administered as part of medical treatment prior to sample acquisition, and that similar to our results, multiple agents were found in only 25% of reported cases, which stands in contrast with previously reported series of MDMA-related deaths from Australia (21) and from other countries (22). This increase in the number of presentations of stimulant drug-associated serotonin toxicity in patrons consuming MDMA may have been due to a variety of factors, including an aberrant increase in the purity of recreational drugs available during the study period. However, in the absence of quantitative data examining drug purity during the study period, we cannot draw any firm conclusion about causality.

Literature on the prehospital presentation, treatment and outcomes of stimulant drug-induced hyperthermia or serotonin toxicity is limited (23). Existing data does suggest a correlation between temperature and mortality (5,8). In a report from Gowing and colleagues, mortality from MDMA-associated drug-induced hyperthermia was reported to be 63% where body temperature exceeded 41.5°C (7). Our series recorded zero deaths, despite six patients

exceeding this threshold. However, a substantial proportion of patients requiring hospital admission had end-organ dysfunction.

Our series also demonstrated the ability of the MAT/HERT model of care to manage patients on site who would otherwise be transported to hospital. Music festivals increase workloads for nearby Emergency Departments (24), and on-site physicians reduce ambulance transports at other forms of mass gathering (25). The NSW guidelines for the management of drug-induced hyperthermia mandate rapid transport to hospital for patients with temperatures of ≥ 39°C, or ≥ 38.1°C where high-risk features are present (26). In our series, 25 patients met these criteria, and 10 (40%) of these were able to avoid hospital transfer. We note that not every provider will be able to deliver the level of care we describe, and we consider the NSW guidelines to be appropriately circumspect. For the severely ill patient, we give organisation of urgent ambulance transport and initiation of cooling strategies (including early administration of benzodiazepines) equal weighting, and the two should occur simultaneously.

The percentage of severely ill patients in our series who were identified as having Asian ethnicity (71%) appears somewhat high compared to nominated ancestries for metropolitan Melbourne during the 2016 ABS Census (Asian ancestry 12%) (27). Associations between Asian ethnicity and MDMA ingestion have been hypothesised as a contributor to critical serotonin toxicity in case reports by Davies and colleagues (15), and Nadkarni and colleagues (16). In the recent coronial inquest (3), four of the six deaths were in patients of Asian extraction. Additionally, men appeared overrepresented in the severe illness cohort (93%). However, statistical analysis showed that relative to the proportions found in the mild (70%) and moderate (55%) cohorts, this result was not significant ($p = 0.059$). It may be that the increased proportion of men overall in this series (68%) is suggestive of increased

susceptibility. However, without reliable denominator data on the proportion of men who ingested MDMA relative to women at the events in question, no conclusion can be drawn. Additionally, it is important to note the very small size of the severe illness cohort; given the small numbers we have included in this analysis, we cannot be certain of the accuracy of these point estimates, and consequently we draw no conclusions from them beyond the generation of further hypotheses and consider it to be an exploratory observation for future studies.

We acknowledge several deficiencies. The data are retrospective and thus may be affected by recording, selection and ascertainment bias. Prehospital reporting of cases of serotonin toxicity is made difficult by the lack of reliable demographic denominator data (24), and the challenges of collecting information in the field, with subsequent linkage to hospital outcomes. Lack of formal prehospital recording of ethnicity data means this variable is only recorded in patients who required hospital transfer. Quantitative analysis of drug consumed by patients, both identity and concentration were not available. Data on recreational drugs was therefore based on patient or bystander history. Some patient demographic and clinic data are missing. These data are of limited magnitude.

To conclude, we have described the clinical presentation and outcomes of a cohort of 47 music festival patrons with stimulant drug-induced serotonin toxicity. In the group of patients presenting with mild or moderate illness, the vast majority of patients were able to be managed successfully on site without recourse to hospital transport. In the group of patients with severe illness (all of whom required hospital transport), zero deaths were recorded despite very high temperatures on presentation. Notwithstanding the early provision of critical care, end-organ impairment in this sub-group was high.

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Tables

Table 1 Prehospital and clinical presentation data

	Mild **N = 13**	**Moderate** **N = 20**	**Severe** **N = 14**	**p-value**
Male sex	9/13	11/20	13/14	0.059
Age	21.4 (19.9 – 23.8)	21.0 (20.0 – 21.6)	20.2 (19.2 – 21.6)	
Drugs reported ingested				
MDMA	11/13	10/20	11/14	
Methamphetamine	0	1/20	0	
LSD	2/13	8/20	1/14	
Ketamine	3/13	8/20	2/14	
GHB	0	1/20	1/14	
Alcohol	4/13	6/20	1/14	
Cocaine	0	1/20	1/14	
Nitrous oxide	2/13	1/20	0	
Cannabinoids	2/13	0	0	
Unknown	1/13	5/20	1/14	
Multiple drug ingestion	9/13	14/20	3/14	0.01
Presenting features				
Clonus	10/13	7/20	4/14	0.02
Rigidity/hypertonia	3/13	4/20	6/14	0.35
Hyperreflexia	0	0	3/14	0.04

Confusion/altered conscious state	7/13	12/20	14/14	0.008
Involuntary movements	5/13	3/20	4/14	0.29
Elevated temperature	0	15/20	14/14	< 0.001
Presenting vital signs				
Heart rate; beats/minute	120 (115 – 142)	135 (126 – 151)	170 (160 – 180)	0.001
Systolic blood pressure; mmHg	139 (128 – 150)	139 (134 – 150)	115 (96 – 120)	< 0.001
Respiratory rate; breaths/minute	24 (22 – 26)	22 (20 – 23)	29 (26 – 44)	0.001
SpO2; %	99 (98 – 99)	97 (95 – 99)	95 (91 – 97)	< 0.001
Temperature; °C	37.4 (36.6 – 37.6)	38.2 (38.0 – 38.5)	41.1 (40.5 – 42.0)	< 0.001
Glasgow Coma Score	15 (13 – 15)	14 (14 – 14)	3 (3 – 10)	< 0.001
Arrhythmia				
Arrhythmia noted during treatment	0	0	4/14	0.01
Prehospital cardiac arrest	0	0	1/14	0.57

MDMA, 3,4-methylenedioxymetamphetamine; LSD, lysergic acid diethylamide; GHB, gamma-hydroxybutyrate.

Table 2 Prehospital treatment and disposition

Characteristic	**Mild**	**Moderate**	**Severe**	**p-value**
	N = 13	**N = 20**	**N = 14**	
Treatment received				
Oral diazepam	5/13	9/20	0	0.008
Dose of oral diazepam; mg	15 (5 – 20)	10 (5 – 10)	0	0.44
Parenteral midazolam	8/13	13/20	13/14	0.12
Dose of parenteral midazolam; mg	10 (3 – 16)	12.5 (9 – 22)	15 (10 – 21)	0.66
Any benzodiazepine	12/13	17/20	13/14	0.85
Anti-serotonergic therapy	1/13	1/20	3/14	0.42
Intravenous fluid	8/13	15/20	14/14	0.03
Volume of intravenous fluid; mL	1500 (1000 – 2000)	1500 (1000 – 2000)	2000 (1500 – 3000)	0.08
Prehospital intubation	0/13	0/20	9/14	< 0.001
Indication for prehospital intubation				
Vomiting/possible aspiration			0	
Decreased conscious state with airway compromise			5/9	
Haemodynamic instability			0	
Temperature control			7/9	

Behavioural control			0	
Other			1/9	
Discharge disposition				
Heart rate; beats/minute	104 (87 – 118)	110 (103 – 145)	162 (149 – 173)	< 0.001
Temperature; °C	36.4 (36.2 – 36.7)	37.4 (37.1 – 37.6)	40.5 (39.4 – 41.7)	< 0.001
Change in temperature between Prehospital admission and discharge; °C	-0.5 (-1.1 – 0.1)	−0.85 (−1.23 – −0.68)	−0.6 (−1.43 – 0.35)	0.49
Average length of prehospital stay; minutes	110 (100 – 175)	128 (98 – 191)	55 (39 – 100)	0.002
Transport to hospital	0	5/20	14/14	< 0.001
Admission to hospital	0	0	14/14	< 0.001

Table 3 Outcome data for patients requiring admission to hospital (n = 14)

Outcome	**Value**
Temperature on arrival to ED; °C	37.4 (35.8 – 39.2)
Change in temperature between prehospital admission and ED admission; °C	−2.65 (−3.38 – −2.08)
ICU admission	14/14
Mechanical ventilation duration; min	1029 (508 – 2020)
Renal replacement therapy	2/14
ICU length of stay; days	1.0 (0.48 – 2.74)
Hospital length of stay; days	4.63 (2.08 – 8.36)
Disseminated intravascular coagulation	2/14
Acute kidney injury	9/14
Acute liver failure	2/14
Cardiac arrhythmia	2/14
Myocardial injury	5/14
Acute respiratory distress syndrome	1/14
Delirium	3/14
Permanent neurological injury	1/14
Any major end-organ complication	11/14
Death	0

ED, emergency department; ICU, intensive care unit.

Table 4 Laboratory test results for patients requiring admission to hospital (n = 14)

Laboratory test	**Value**	**Normal values**
Peak lactate; mmol/L	2.70 (2.25 – 5.50)	< 2.0
Peak potassium; mmol/L	4.50 (3.95 – 5.30)	3.5 – 5.0
Nadir sodium; mmol/L	139 (137 – 140)	135 – 145
Peak creatinine kinase; IU/L	19212 (5238 – 47129)	22 – 198
Peak troponin I; ng/L	2435 (81 – 10313)	< 40
Peak urea; mmol/L	7.5 (5.6 – 8.7)	3.0 – 8.0
Peak creatinine; µmol/L	147 (110 – 188)	60 – 110
Peak prothrombin time; s	17.3 (15.4 – 19.7)	11.0 – 15.0
Peak alanine aminotransferase; IU/L	154 (29 – 1505)	< 35
Nadir albumin; g/L	32 (28 – 36)	32 – 45

Figure legends

Figure 1 Modified Hunter Serotonin Toxicity Criteria used to determine eligibility for inclusion in the study.

Figure 2 STROBE-style study flowchart outlining screening to and exclusion from the analysis sample.

Event Number	Event type	Peak environmental temperature (°C)	Location	MAT/HERT	Estimated attendance	Total cases	Total drug-related presentations	Total 5-HT toxicity	Total severe 5-HT toxicity
1	Outdoor, Multiday Residential Festival	32	Regional	MAT	18000	557	65	0	0
		24.8						1	1
		20						0	0
		23.9						0	0
		24.9		HERT	18000	28	10	0	0
2	Outdoor Venue - Single Day	24.8	Metro	MAT	5000	109	5	0	0
3	Outdoor Venue - Single Day	25.3	Metro	HERT	3000	13	0	0	0
4	Mixed - Indoor/Outdoor - Single Day	25.3	Metro	HERT	1500	14	3	0	0
5	Indoor Venue - Single Day	34.5	Metro	HERT	5000	28	0	0	0
6	Outdoor Venue - Single Day	24.6	Metro	HERT	4000	8	0	0	0
7	Outdoor Venue - Single Day	28.2	Metro	HERT	4000	3	0	0	0
8	Indoor Venue - Single Day	28.4	Metro	HERT	5000	16	7	6	6
9	Indoor Venue - Single Day	28.1	Metro	MAT	5000	9	1	0	0
10	Outdoor Venue - Single Day	28.1	Metro	MAT	15000	97	2	0	0
11	Outdoor Venue - Single Day	27.6	Metro	MAT	5000	117	8	2	0
12	Indoor Venue - Single Day	29.9	Metro	HERT	4750	5	0	0	0
13	Outdoor Venue - Single Day	30.3	Metro	HERT	14000	21	2	0	0

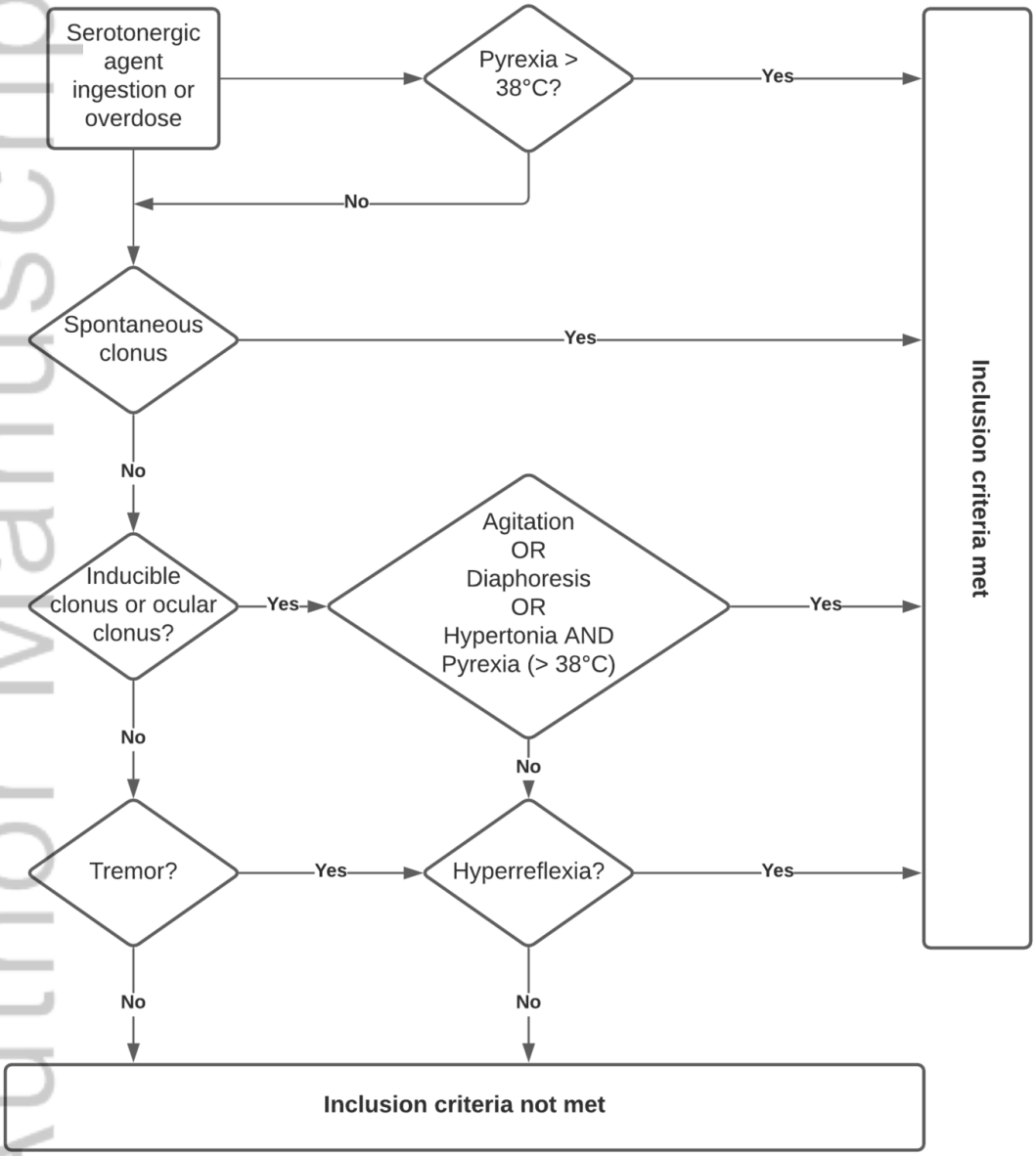
14	Outdoor Venue - Single Day	29.3	Metro	HERT	12000	39	0	0	0
15	Outdoor Venue - Single Day	24	Metro	HERT	6500	25	1	0	0
16	Outdoor Venue - Single Day	32	Metro	HERT	10000	20	0	0	0
17	Outdoor, Multiday Residential Festival	34.9	Regional	MAT	5000	31	13	0	0
		31.4	Regional	MAT	5000	89	21	0	0
		20.8	Regional	HERT	5000	47	11	0	0
		29.5	Regional	HERT	5000	2	0	0	0
18	Outdoor Venue - Single Day	31.6	Metro	MAT	18000	97	6	0	0
19	Outdoor Venue - Single Day	32.8	Regional	HERT	20000	61	0	0	0
20	Outdoor, Multiday Residential Festival	33.9	Regional	MAT	2000	8	0	1	0
		35.6	Regional	MAT	2000	36	10	3	0
		35.7	Regional	MAT	2000	27	3	0	0
21	Outdoor, Multiday Residential Festival	28.8	Regional	MAT	10000	31	5	0	0
		28.2	Regional	MAT	10000	171	29	2	0
		22.3	Regional	MAT	10000	134	23	0	0
		14.5	Regional	MAT	10000	60	8	0	0
		15	Regional	MAT	10000	10	0	0	0
22	Outdoor Venue - Single Day	24	Metro	MAT	8200	66	4	0	0
23	Indoor Venue - Single Day	24.2	Metro	MAT	6500	48	10	0	0
24	Outdoor Venue - Single Day	29.9	Metro	HERT	8000	36	10	0	0
25	Outdoor Venue - Single Day	20.2	Metro	MAT	4000	9	5	1	1
26	Outdoor Venue - Single Day	22.8	Metro	HERT	3000	5	1	0	0

27	Outdoor Venue - Single Day	17.2	Metro	MAT	4000	20	6	1	0
28	Outdoor Venue - Single Day	19.8	Regional	MAT	18000	216	9	1	0
29	Indoor Venue - Single Day	13.6	Metro	MAT	7500	12	0	0	0
30	Indoor Venue - Single Day	15.6	Metro	HERT	3000	10	6	0	0
31	Indoor Venue - Single Day	13.4	Metro	MAT	7500	26	8	1	0
32	Indoor Venue - Single Day	24.2	Metro	MAT	7000	23	8	1	0
33	Outdoor Venue - Single Day	24.9	Metro	HERT	5500	37	0	0	0
34	Outdoor Venue - Single Day	24.9	Metro	HERT	2000	12	6	0	0
35	Indoor Venue - Single Day	24.9	Metro	HERT	2500	9	2	0	0
36	Outdoor Venue - Single Day	16.1	Metro	MAT	12500	9	0	0	0
37	Outdoor Venue - Single Day	20.3	Metro	HERT	50000	66	2	1	0
38	Outdoor Venue - Single Day	17.2	Metro	MAT	12000	113	14	1	0
39	Indoor Venue - Single Day	38	Metro	MAT	4500	16	4	4	4
40	Outdoor Venue - Single Day	20.1	Metro	HERT	3900	6	1	0	0
41	Outdoor Venue - Single Day	24.8	Metro	HERT	5000	74	13	0	0
42	Outdoor, Multiday Residential Festival	36.1	Regional	MAT	11000	87	2	2	0
		24.6	Regional	MAT	18000	185	18	3	0
		23.7	Regional	MAT	18000	267	38	2	0
		27.5	Regional	MAT	18000	279	17	3	0
		27.7	Regional	HERT	18000	32	5	1	0

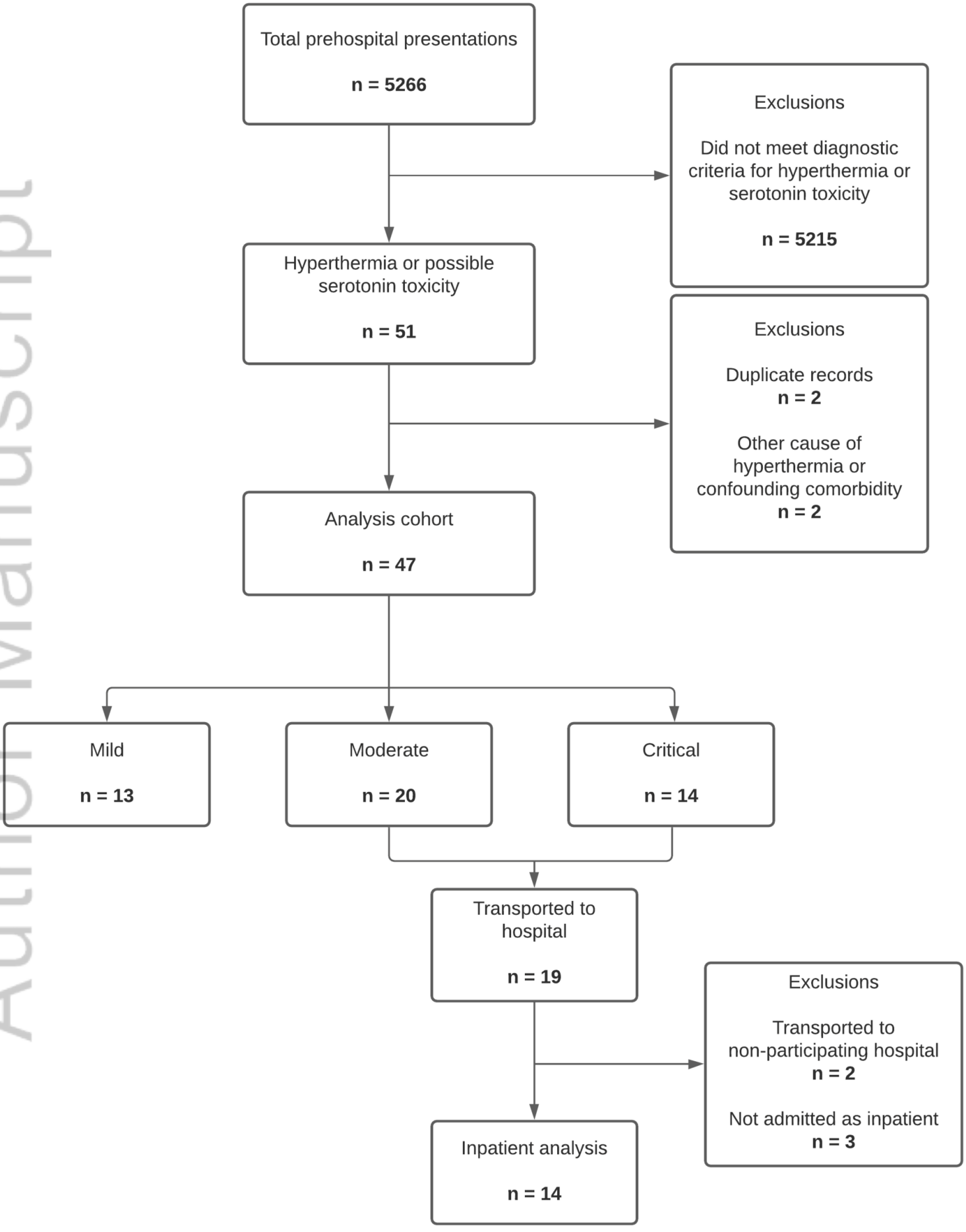
43	Outdoor Venue - Single Day	24.6	Metro	MAT	5000	106	21	0	0
44	Outdoor Venue - Single Day	26.2	Metro	HERT	3000	16	3	0	0
45	Outdoor Venue - Single Day	26.2	Metro	HERT	2000	8	1	0	0
46	Indoor Venue - Single Day	29.5	Metro	HERT	3000	1	0	0	0
47	Indoor Venue - Single Day	42.6	Metro	HERT	3500	2	0	0	0
48	Indoor Venue - Single Day	21.4	Metro	HERT	5000	0	0	0	0
49	Outdoor Venue - Single Day	28.7	Metro	HERT	12500	5	0	0	0
50	Outdoor Venue - Single Day	23.3	Metro	HERT	20000	62	0	0	0
51	Outdoor Venue - Single Day	22.9	Metro	MAT	8500	27	5	0	0
52	Outdoor Venue - Single Day	26.8	Metro	HERT	12500	18	0	0	0
53	Outdoor Venue - Single Day	23.9	Metro	HERT	12500	9	0	0	0
54	Indoor Venue - Single Day	26.1	Metro	HERT	3000	12	3	0	0
55	Indoor Venue - Single Day	34.4	Metro	HERT	5000	10	0	0	0
56	Outdoor Venue - Single Day	28.3	Metro	HERT	4500	9	0	0	0
57	Outdoor Venue - Single Day	21.5	Metro	HERT	12000	41	0	0	0
58	Outdoor Venue - Single Day	19.7	Metro	MAT	20000	167	7	0	0
59	Outdoor Venue - Single Day	19.2	Metro	MAT	12500	8	1	0	0
60	Outdoor Venue - Single Day	23.2	Metro	MAT	12500	7	3	0	0

61	Outdoor Venue - Single Day	22.8	Metro	MAT	12500	14	1	0	0
62	Outdoor, Multiday Residential Festival	30.6	Regional	MAT	8000	55	11	1	0
		32.6	Regional	MAT	8000	78	0	0	0
		33.3	Regional	MAT	8000	82	17	0	0
		31.2	Regional	MAT	8000	3	0	0	0
63	Outdoor Venue - Single Day	32.9	Metro	MAT	12500	50	12	0	0
64	Outdoor Venue - Single Day	38.1	Regional	HERT	20000	145	0	0	0
65	Outdoor, Multiday Residential Festival	18.7	Regional	MAT	12500	36	10	0	0
		23.1	Regional	MAT	12500	139	29	3	0
		15.7	Regional	MAT	12500	163	18	1	0
		13.8	Regional	HERT	12500	60	16	1	0
66	Outdoor Venue - Single Day	20.8	Metro	MAT	12500	14	5	0	0
67	Outdoor Venue - Single Day	31.3	Metro	MAT	8000	24	0	0	0
68	Outdoor Venue - Single Day	15.6	Metro	MAT	10000	69	30	0	0
69	Outdoor Venue - Single Day	20.1	Regional	HERT	1000	11	0	0	0
70	Outdoor Venue - Single Day	20.5	Metro	MAT	8000	95	10	0	0
71	Outdoor Venue - Single Day	29.2	Metro	HERT	6000	50	13	0	0
72	Indoor Venue - Single Day	30.2	Metro	MAT	2000	11	4	0	0
73	Indoor Venue - Single Day	24.3	Metro	MAT	8000	83	4	4	2
					846850	**5266**	**646**	**47**	**14**

Abbreviations: HERT, Health Emergency Response Team; MAT, Medical Emergency Team.



7-SIGMA_Figure 1.png



7-SIGMA_Figure 2.png