

Holy Shroud Exhibition 2010: Health Services During a 40-Day Mass-Gathering Event

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Abbreviations:

ALS: advanced life support
AED: automatic external defibrillator
EMS: Emergency Medical Services
EMT: emergency medical technician
EOP: emergency operations plan
HVA: hazard and vulnerability analysis
MCI: mass-casualty incident
METH: medical center to the hospital
PPR: patient presentation rate
SCD: sudden cardiac death
SOP: standard operating procedures
TTHR: transport to hospital rate

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Abstract

Introduction: Mass-gathering events require varying types and amounts of medical resources to deal with patient presentations as well as careful planning for environmental health management. The Holy Shroud Exhibition was hosted in Torino, Italy, between April and May 2010. The venue was a unique mass-gathering event which lasted several weeks. It was held in a limited area in the center of the city and it was attended by a large and heterogeneous population. A dedicated Health Care Service was created for the event. **Methods:** This study is a retrospective analysis of clinical presentations of patients who were managed by the Medical Services during the event. The main study outcomes included Patient Presentation Rate (PPR), type of injuries and illnesses, and the Transport to Hospital Rate (TTHR).

Results: The PPR and TTHR were both low (0.27 and 0.039 respectively). The majority of patients presented with low severity codes and no sudden cardiac death (SCD) or cardiac arrest occurred. Cardiac and trauma emergencies were most frequent categories of presentation. A number of pediatric patients (19.37%) were treated by the event Medical Service. Approximately two million persons participated in the 40-day event.

Conclusion: The experience for this 40-day event supported having an on-site, organized, dedicated Medical Service that decreased overcrowding of the local Emergency Medical System and hospitals. It is recommended that, for such events, there be recruitment of emergency physicians with experience in mass-gathering events, recruitment of pediatricians, and training for professionals during the planning process.

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Introduction

Mass-gathering events occur when a large number of individuals gather in a specific place for a specific purpose.¹ It is known that health care is an important service during mass-gathering events. The "Holy Shroud Exhibition 2010" was hosted in Torino (Italy) from April 10, 2010 through May 23, 2010. The venue was a 43-day religious exhibition; more than two million local and international visitors attended the event.

To support the event, an ad hoc health care service, called Medical Service, was created to provide aid and medical care for attendees. The Medical Service was prepared to intervene in case of a mass-casualty incident in cooperation with the "Servizio Emergenza Territoriale 118 Torino" (called SET 118 Torino, in English EMS 118 Turin) as well as other agencies.

The Holy Shroud Exhibit is held approximately every twenty years, with the past exhibition being during the Jubilee in 2000. According to Christian-Catholic tradition, the dead body of Jesus Christ was wrapped in the linen Holy Shroud after the Deposition and it presents an image of Christ that behaves like a negative film.² The Holy Shroud Exhibition is a religious mass-gathering event that lasts several weeks and is held in a bounded area in the center of the city, including spaces around and inside the Cathedral.

Medical Service was organized as a health care system that was able to provide immediate aid for religious pilgrims and tourists participating in the event. The system was prepared for managing both minor and severe medical cases, with the intent of allowing normal daily activity for EMS and hospitals close to the venue locations.

Several mass-gathering events are held annually in the world, but medical literature is limited to a few papers and guidelines that address medical care organization. This is

particularly true for mass-gathering religious events that occur over a few weeks with more than two million people at the venue (center of a city). The aim of this investigation is to describe and analyze the nature, acuity and disposition of first aid presentations at the event Medical Center during the 42 days of the event. This analysis was intended to better understand and evaluate the needs and development of resources (staff, materials, and structures) and the role of the Medical Services for this kind of mass-gathering event.

Patients and Methods

This study was a retrospective analysis of cases that were managed by the Medical Services during the event. In the autumn of 2009, the “Comitato per la Ostensione della Sindone—Torino 2010” was formed as a Committee with the aim to plan, prepare and work for the venue. The Planning Committee was established by the Mayor of Torino and the Bishop of Torino. A section of the Committee, named Medical Services, was created to take charge of health care services. The Medical Services Committee conducted research on legislation and medical literature concerning mass-gathering events preparation. A Hazard and Vulnerability Analysis (HVA) was performed as well. Ordinary medical activities were included in Standard Operating Procedures (SOP), and a mass-casualty incident (MCI) plan was developed as part of an Emergency Operations Plan (EOP), both drawn up by the Medical Services.³

The medical assistance organization consisted of a Medical Center set in the outer part of the venue, a Medical Station on the route of pilgrims inside the Cathedral, and ground teams located around the venue. Medical assistance was available every day of the event from 6:30 AM to 10:30 PM.

An advanced life support (ALS) team composed of a physician, a nurse and two emergency medical technicians (EMTs) was located inside the Medical Center where space was allocated for ambulatory treatment, a resuscitation room and a waiting room that allowed for re-evaluation of patients before their discharge or hospitalization. Physicians were volunteers, and had different experience and backgrounds (general practitioners, surgeons, orthopedists, emergency physicians, cardiologists and internal medicine specialists).

The Medical Station was established in the inner part of the venue with an ALS team and emergency room. Ground teams were composed of two EMTs and, occasionally, a nurse. The number of ground teams tended to change from day to day depending on the number of attendees. The ground teams were equipped with an automatic external defibrillator (AED) and a first aid bag.

The headquarters for Medical Services was established in the Medical Center and either the Medical Director or his deputy was present at the venue at all times. In case of an MCI or disaster, either the Medical Director or his deputy was to assume the role of Medical Incident Commander and coordinate the response in cooperation with the SET 118 Torino. This was planned to improve surge capacity and optimize resources, personnel and facilities, in particular in the case of a NBCR (nuclear, biological, chemical, radiological) emergency.

Medical Services staff members were volunteers. During the exhibition, two doctors and two nurses were present, with 16 EMTs and three ambulances located close to the Cathedral. First aid assessment and treatment was provided for more than 12 hours on each of the 42 days (19,472 hours) by 500 medical providers, including physicians, nurses, and more than 1600 EMTs.

When a medical emergency occurred, the ground teams first moved to the patient and made a general assessment of the medical condition. In contact with the Medical Director, it was decided to treat the patient directly on site, or to transfer the person to the Medical Center/Medical Station for evaluation. Transfers of patients inside the venue were generally performed by one of the ambulances located in strategic locations. Each patient was registered and data recorded in a standard database. Age, gender, birthplace, cause of access, time of presentation and time of discharge/hospitalization, medical history, and medical data were collected. Data were collected after obtaining informed consent. Patients were triaged and assigned a priority color code (white, green, yellow or red) and a pathology numeric code (0 alcoholic-related, 1 trauma, 2 cardiac, 3 respiratory, 4 neurologic, 5 psychiatric, 6 cancer-related, 7 intoxication, 8 other, 9 unknown), according to the codes in use by EMS 118 Turin.

After a physical check performed by a physician, patients were discharged immediately, remained in observation, or were transferred to a hospital. For hospital transfers, Medical Services decided together with the SET 118—Torino the fastest method for transferring the patients to the closest and most appropriate hospital for patient's medical needs.

Excluded from data were cases on May 2, 2010, when Pope, Benedetto XVI came to visit the Holy Shroud Exhibition. During that day, the venue area was located in another part of the city with other resources, and Medical Services was adapted for this one-day event (see Appendix 1).

The Patient Presentation Rate (PPR) (casualties and patients presenting per 1,000 visitors), the Transport to Hospital Rate (TTHR) (the number of patients transported to hospital per 1,000 visitors in attendance) and Medical Evacuation from the Medical Center to the Hospital (METH) were outcome measures of interest.

Continuous variables were reported as means plus or minus standard deviations. The association between the number of patients involved in the data collection and event census was ascertained using multivariate linear modeling with a *P*-value $\leq .05$ accepted as statistically significant. All analyses were performed in the R-environment.

Results

During the 42 day event, 2,113,128 people attended the “Holy Shroud Exhibition 2010,” with 583 interventions by the Medical Service. Some were likely assisted by the Medical Service without complete data being collected.

The PPR (casualties and patients presenting per 1,000 visitors) was 0.27, the TTHR (the number of patients transported to hospital per 1,000 visitors in attendance) was 0.039 and METH was 14.6. Data about the number of total visitors and the patients treated by Medical Services are presented in Table 1.

Of the patients presenting for Medical Services, 360 (61.75%) were female and 223 (38.25%) were male. Mean age was 47.8 years old (range: 2 yrs to 110 yrs) and median age was 51 years, with 67 patients (11.49%) being 75 years or older. The majority of the patients were Italian (520 patients, 89.20%) with most from outside the city of Torino (434 patients, 74.96%).

The most common emergency presentations during the Exhibition were cardiologic (176; 30.2%), which included complaints of asthenia, fainting, arrhythmias, and cardiac chest pain. Trauma accounted for 115 (19.7%) of cases. Less common

Week	Dates in 2010	Attendees	Cases	METH	METH %	Chi square ^a	PPR (x1000)	PPR (OR)	Chi square
1	April 10-16	276,069	66	20	30.3	0.0053	0.24	ref.	0.0001
2	April 17-23	318,611	95	9	9.5		0.30	1.25	
3	April 24-30	351,216	88	12	13.6		0.25	1.05	
4	May 1-7	393,701	68	10	14.7		0.17	0.72	
5	May 8-14	352,213	106	11	10.4		0.30	1.26	
6	May 15-22	421,318	144	21	14.6		0.34	1.43	
Total		2,113,128	567	83	14.6		0.27		

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Table 1. Characteristics of Attendees and Patients

^aA chi square test calculated on weeks 2-6 showed no heterogeneity in METH (P -value = .6997).

conditions were respiratory (19; 3.3%), neurological problems (46; 7.9%), psychiatric conditions (11; 1.9%). One hundred forty-five patients (24.9%) presented with conditions classified as other (eg, abdominal pain, vertigo) and 60 patients (10.3%) were classified as unidentified (Table 2).

As expected, only one patient (0.2%) presented with alcohol intoxication. Low alcohol use has previously been reported as an aspect of Papal visits⁴ or religious mass-gathering events. No sudden cardiac death (SCD) or cardiac arrest was observed during the event. The literature reports that estimates of the incidence of SCD are variable, but may be as high as one to four per 1,000,000;⁵ therefore, two cases would have been expected during this 2,000,000 attendee event.⁶

The weather conditions during the event were fair, except during the fourth week which was colder and rainy. In the other weeks, temperature and humidity could be compared to the typical Mediterranean spring weather of warm and sunny.

Patient Presentation Rate (PPR)

Heterogeneity of PPR during the six weeks of the event was noted (Table 2). During the second and the last two weeks of the exhibition, there was an increase of PPR with an augmented Relative Risk of 1.25, 1.26 and 1.43 respectively. The relative risk was conversely reduced (0.74) during the fourth week (see Figure 2).

Transport to Hospital Rate (TTHR) and Medical Evacuation from the Medical Center to the Hospital (METH)

Eighty-three patients (14.5% of total) were transferred to a city hospital. The overall TTHR was 0.039/1000 attendees. During the exhibition there were no cardiac arrests, as mentioned, and only one patient was triaged as a red code with a final diagnosis of subarachnoid hemorrhage.

Analysis was performed on the overall TTHR and METH (Table 1). It was found that there was a significant heterogeneity for METH during the different weeks. The highest METH (30.3%) was observed in the first week, and was significantly different ($P < .00012$) from the METH observed during the remaining five weeks (12.5%). The odds ratio (OR) calculated was 3.04 (Table 2 and Figure 1). Possible causes of augmented risk of METH were analyzed. Patients were grouped by ages in three different classes: 0-16 (pediatric), 17-74 (adult), and

>74 (elderly). A great number of pediatric patients (age 0-16) (111 patients, 19.37%) were accepted at the Medical Service and had a significantly ($P = .0009$) lower METH (5.4%) than other age groups (14.6% and 25.4% respectively). Also found was a correlation between triage code and METH, with white code (delayed) having a lower chance ($P < .0001$) than green (minor) and yellow or red (major) of being sent to hospital. A strong correlation between trauma and METH was observed in comparison with other conditions, with an Odds Ratio = 2.20. Major medical problems needing hospital transfer were respiratory problems (METH = 30.4%). Analysis of vital parameters revealed a correlation between hospitalization and higher values of maximum arterial blood pressure. Finally, provenance of patients did not show any effect on METH, because rates were similar for Italians and foreigners, residents and non-residents in Torino.

Limitations

This study is limited to a single event occurring over an extended period of time, which is unusual. As a retrospective study, there are a number of limitations associated with this methodology. Moreover, a small number of patients requiring minor medication and treated by the EMTs were not captured in the database. Therefore, the number of patients is underestimated.

Discussion

Mass-gathering events are an important challenge, in particular when they last several weeks and have unique characteristics. These events allow identification of factors that could have an impact on the public safety of people attending them. During a mass-gathering event, the institution of a health care service in charge of providing first aid is essential. Other key points of the health care service are immediate advanced care for attendees, and possibly avoidance of overcrowding hospitals closest to the venue with minor code presentations. Medical resources must be deployed in these events in a thorough and efficient manner based on reasonably expected needs.⁷

In cases like the Holy Shroud Exhibition, it is very difficult to predict factors that could have an impact, as well as the number of patients needing health care and their medical problems. Medical literature about mass-gathering and religious events is limited. Religious events and Papal visits, as reported by Milstein et al, have visitors of every age, including the elderly and ill. Compared

		Transfer		Total	%	P-value	OR
		No	Yes				
		490	83	573	14.5	.20	
Torino	No	368	66	434	15.2		
	Yes	109	13	122	10.7		
	Lost data	13	4	17	23.5		
Italy	No	41	10	51	19.6	.39	
	Yes	447	73	520	14.0		
	Lost data	2	0	2	0.0		
Weeks	1	46	20	66	30.3		
	2	86	9	95	9.5		
	3	76	12	88	13.6		
	4	58	10	68	14.7		
	5	95	11	106	10.4		
	6	123	21	144	14.6		
	?	3	0	3	0.0		
First Week	Yes	46	20	66	30.3	.00012	3.04
	No	441	63	504	12.5		ref.
	Lost data	3	0	3	0.0		
Triage	White	370	10	380	2.6	<.0001	ref.
	Green	106	51	157	32.5		17.80
	Yellow/Red	3	20	23	87.0		246.6667
	Lost data	11	2	13	15.4		
Trauma	No	443	67	510	13.1	.013	ref.
	Yes	45	15	60	25.0		2.20
	Lost data	2	1	3	33.3		
Pathology code	alcoholic related	1	0	1	0.0		
	trauma	80	35	115	30.4		
	cardiac	161	15	176	8.5		
	respiratory	14	5	19	26.3		
	neurologic	41	5	46	10.9		
	psychiatric	11	0	11	0.0		
	other	130	15	145	10.3		
	unknown	52	8	60	13.3		
Age	0-16	105	6	111	5.4	.0009	ref.
	17-74	310	53	363	14.6		2.99
	75+	50	17	67	25.4		5.95
	Lost data	25	7	32	21.9		

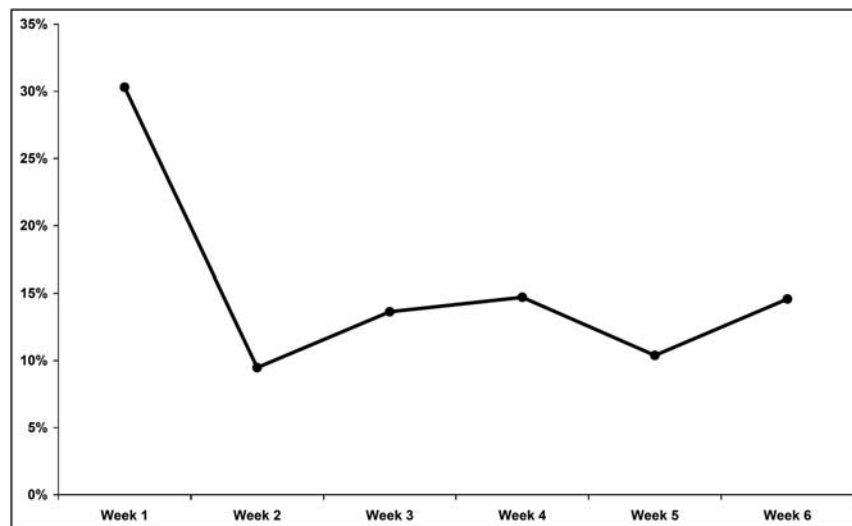
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Table 2. Transfer by Clinical Features of Patients (*continued*)

		Transfer		Total	%	P-value	OR
		No	Yes				
Blood Pressure		339	56	395			
Systolic	Media	127.68	143.20	129.88		<.0001	
		338	54	392			
Diastolic	Media	79.80	83.37	80.57		.08	

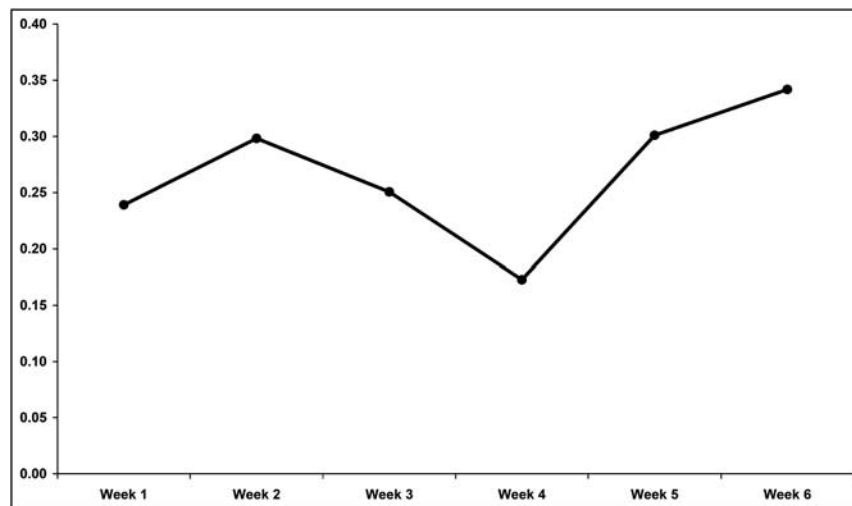
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Table 2. (continued) Transfer by Clinical Features of Patients



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Figure 1. Medical Evacuation from the Medical Center to the Hospital (METH)



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Figure 2. Patient Presentation Rate (PPR)

to other mass-gathering events, there are more elderly persons and an absence of drug and alcohol-related problems.^{4,8}

In this study, PPR (0.27/1000), TTHR (0.039/1000), and METH (14.6%) were low, probably in accordance with the type of event and the health condition of attendees. Furthermore, low TTHR and METH may be attributed primarily to the on-site

presence of physicians and the Medical Services which may have been able to reduce the impact on the local EMS system and surrounding medical facilities as previously described in another study.^{7,9,10}

A statistical difference was observed in PPR during the different weeks of the venue. During the fourth week, bad

weather conditions probably caused a decrease in the number of visitors, and favored those who were younger and healthier. During the fifth and sixth weeks, there was an increase of total attendees and consequently of PPR in conjunction with the visit of the Pope and the end of the exhibition. No other specific causes to explain the fluctuation in the number of visitors and PPR were found.

To understand the role of the Medical Services, data and factors having an impact on patient discharge after treatment by the Medical Services in the venue or the eventual transfer to the hospital (TTHR and METH) were analyzed. Transfer to hospital rate and METH were significantly higher during the first week of the exhibition. This, in the authors' opinion, can be correlated with the skill of the medical personnel with a typical experience learning curve as the event progressed (Figure 1). The medical personnel present at the exhibition were not always emergency physicians, but also orthopedists, surgeons or general practitioners. Different specific knowledge may have influenced the ability to treat a patient on site. No problem related to misdiagnosis, other medical mistakes or medical complaints were found with any of the patients treated by the Medical Services.

The efficiency of an ad hoc health care service for an event like this is greater when all personnel have appropriate skills. This means an immediate advanced treatment capability should be in place in case of major code and for a reduction of TTHR and METH for the minor codes in the first days of the venue.

This study stresses the importance of including certain medical staff in planning for mass-gathering events, particularly pediatricians. The age of patients presenting at the Medical Center was low (0-16 years in 111 patients, 19.0%). Most were discharged from the Medical Center, with only one percent transferred to a hospital. Most of the medical needs in a population attending a children's fun fair are minor, as Thierbach et al described.¹¹ In the case where there is not the opportunity to have a pediatrician available, adequately training physicians and nurses in basic care of children before the event may be a consideration.

Organization of the medical teams during this venue showed that recruitment of emergency physicians or doctors who have experience in mass-gathering events can improve the efficiency and organization of medical care, and that training and updating professionals who take part in providing care during mass-gathering events can be valuable.

Conclusion

This study showed a low rate of acuity and presentation for medical services during a long-term, religious-based, mass-gathering event. It was demonstrated that organizing a dedicated Medical Service is important in planning for mass-gathering events. Such planning and implementation avoids overcrowding the local EMS system and local hospitals. The health care organization described could be a model for long-lasting events. Finally, pediatric cases often present in this type of event, and involvement of pediatricians should be considered.

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Appendix 1

The visit by His Holiness Pope Benedict XVI to the Holy Shroud and to the city of Torino on May 2, 2010 was a unique event in the course of the exhibition. During that day, the venue area was located in another part of the city, with other resources, and the Medical Service was adapted for this one-day event.

The visit attracted a crowd of 100,000, including many frail, disabled and elderly people. This fact was a considerable concern for those who had to arrange medical facilities for the visit. Medical arrangements were operated by the same Medical Committee which had planned the whole Holy Shroud exhibition.

The medical facilities allowed for 12 ambulances, seven of which were equipped for ALS, disseminated in strategic positions of the area. Two advanced medical posts, with one doctor, one nurse, EMTs and some beds were the main back-up diagnostic and treatment facilities on site. Ground teams equipped for Basic Life Support were placed inside the area in order to provide

first-aid rescue. Eleven doctors, 11 nurses and 26 EMT teams were present at the venue. If more prolonged admission or more sophisticated facilities were required, patients were transferred to one of the six local hospitals, or if necessary to more specialized hospital (Trauma Center, Pediatric, Obstetric or Gynecological Center.)

The bulk of the medical work was carried out by the ground teams and by the first-aid posts and ambulances. Mostly there were minor complaints like asthenia and fainting or minor trauma; therefore, many events were not inserted in the database (patients requiring minor medication and treated by the EMTs likely were not recorded). Twenty-three patients required assistance by the advanced medical recovery station, and 10 of these patients were referred for further treatment to local hospitals.

No major injuries were observed during that day, and the Medical Service provided effective first- and second-tier health care service, therefore avoiding overcrowding of the local Emergency Medical System and local hospitals.