

Estimation of Healthcare Resources at Sporting Events

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Competing Interest

The authors declare that they have no competing interests.

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Abbreviations:

PKMC = Prehospital and Disaster Medicine Center
VAS = Visual Analogue Scale

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Abstract

Background: The consequences of a major incident at a sporting event could be catastrophic. Therefore, there should be an estimation of the healthcare resources at such events as part of the planning. Although there are National guidelines (e.g., Planning Safe Public Events: Practical Guidelines in Australia) defining the role of the healthcare system at sporting events, these guidelines either lack a simple calculating method to estimate the need for healthcare resources or the methods are complex and impractical to use. The objective of this study was to find a safe and easy method for the estimation of healthcare resources at sporting events.

Methods: A model for the estimation of healthcare resources at music events recently has been approved in Sweden. After minor adjustments, this model was used at sport events by a number of planning officers. The models' accuracy and usability was evaluated by analyzing its outcome in a pilot and a controlled study using different sporting and non-sporting scenarios.

Results: The pilot study showed that the model was valid and easily could be used for various sporting events. The obtained estimations were consistent with the methods used by experienced planning officers in 97% of cases. The results of the controlled study showed that by using this model, the minimum amount of resources required easily could be calculated at sporting events and by people with different backgrounds.

Conclusions: This model safely can be used at sporting events.

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Background

There is an international concern for public safety and its medical needs at sporting events. A *public event* (planned or unplanned) is defined as a gathering of a larger number of people in a restricted area. At such a gathering, there is a statistically increased risk that someone among spectators or participants, will need acute medical care, or that an unexpected event may take place.^{1–3} A number of serious incidents associated with sporting events, whether terrorist or non-terrorist generated, have been reported, e.g., the killing of Israeli athletes by terrorists at the 1972 Olympic Games in Munich,⁴ the hooligan riots at Heysel stadium in Belgium in 1985 (39 dead, 600 injured),⁵ and the panic in the stands during the Hillsborough incident in England in 1989 (94 dead, 766 injured).⁶ However, some of the incidents could have been prevented and the disasters avoided by ensuring appropriate crowd control and adequate risk assessment. Thus, a “Risk Assessment Tool” to enable a reliable assessment of the level and extent of appropriate healthcare resources is needed.^{1,7–10}

In a recent review, 10 areas of public health planning for the London 2012 Olympic and Paralympic games were identified, and a thorough planning and risk assessment were recommended.¹¹ However, the majority of risk assessments and planning procedures deal with logistics, organizations, and detection of medical conditions and injuries during sporting events. Although there are

guidelines for estimation and implementation of healthcare resources at music events (the number of ambulances, first-aid workers, nurses, and doctors needed), similar guidelines for sporting-related events are not available.^{1-3,7,8,12}

The safety of people attending a mass gathering depends largely on crowd management. Crowds are the common denominator for many music and sporting events.⁸ The composition of the crowd varies depending on the type of event. Thus, a generic model developed for estimating healthcare resources at music events, could be adaptable to use at many sporting events.

The Event Safety Guide published and used in the UK offers a template to assess the needed resources at a music event.^{8,9} This template has been validated and used in the UK, and was recently adjusted, tested, and validated for use in Sweden.¹³ The template is easy to use and the estimation, based on the template, can be performed by people without healthcare knowledge (organizers). The successful use of this template led to the idea of using such a validated template for sporting events. Thus, the objective of this study was to find out if this template could be safely and easily used for estimation of healthcare resources at such events in Sweden.

Methods

Pilot Study

A pilot study was conducted with the participation of six experienced prehospital and ambulance healthcare providers (prehospital nurses with >10 years of experience in prehospital emergency care and public event planning) from three different districts in the Region Västra Götaland. After using the model in several ongoing regional sporting events ($n = 15$), they completed a questionnaire with questions using a Visual Analogue Scale (VAS) 1–10 (0–100%). The VAS is a measurement instrument that is used to measure a characteristic or attitude that is believed to range across a continuum of values and cannot easily be directly measured. The VAS-scale is determined by measuring in millimetres from left end of the line to the point that subject marks. The questions consisted of: (1) “How easy was the guideline to use?”; (2) “How useful was this guideline for your planning and in discussions with operators?”; (3) “Did the outcome of your calculation match with your previous calculation of the same event?”; (4) “Have you ever used a similar guideline for resource planning? When and where?”; (5) “Have you used this guideline at a sporting event?”; (6) “Has the guideline matched up to your expectations/experience?”; and (7) “To what extent do you think this guideline would be used, if available?”

Survey (Including Control Study)

A survey was conducted in three steps: (1) training how to use the original template; (2) using the templates in fictitious music events ($n = 3$) with known outcomes; and (3) control study using the new adapted template in fictitious sporting events ($n = 3$) with known outcomes. The test group included 27 participants with different backgrounds (emergency medical services planners, not necessarily healthcare workers). However, they all were experienced in the assessment of healthcare resources at public events and responsible for such assessments in their area. None were included

in the pilot study. All scenarios in steps 2 and 3, were taken from actual events where resource uses were known. The key results were determined by Prehospital and Disaster Medicine Centre (PKMC) in Gothenburg and were used as the reference to compare participants' outcome during evaluation of the study. The PKMC was used as a reference group because it developed and published the Swedish version of the Event Safety Guide.¹³

Step 1: To learn how to use the original template (Appendix 1, used during music events)—All participants were trained in using the original template before applying it to six fictitious event scenarios in steps 2 and 3. The original calculating template classifies an event based on 12 different parameters. Each of these parameters provides a numerical descriptor, i.e., the type of event offers 18 different choices. Choosing a type of event leads to a score between 2–9. In the same order, each of the remaining 11 parameters, which include everything from an expected number of visitors to the season of the event, also give a score. The sum of all of the scores in different sections (A–L) provides the corresponding overall numeric value for the recommended number of ambulances, first-aid workers, doctors, and nurses deemed necessary for the event (Appendix 1).

Step 2: Evaluation of the participants' knowledge; using the original template in three non-sport events' scenarios (Appendix 1, used during music events)—All participants used the original template to estimate the needed healthcare resources in non-sporting event scenarios. Three scenarios were chosen: (1) the Swedish National Day celebration; (2) a festival; and (3) a concert.

Step 3: Approval and adaptation of the designed template for sport events—In the original template (Appendix 1), there are 12 different choices of events. One of these choices requires a risk assessment for the risk of a disturbance at the event (demonstration/marches/political events). By adding sporting events into this category, as a separate parameter, the planning officer was made to classify the events as: (1) low risk of interference; (2) medium risk of disorder; (3) high risk of disturbance; and (4) the risk for encounter between rival groups. Then, they must continue to select a score for each of the remaining 11 parameters to obtain a sum as a basis for the recommended healthcare resources at the event (Appendix 2).

Evaluation of the Template in Swedish Premier League in Football The utility of the template was tested in four matches in the Swedish premier soccer league (Allsvenskan).

Results

Pilot Study

The results of the pilot study indicated that the template was easy to use (100%). More than 75% of the participants found it useful and comparable with their own method for estimation. Subsequently, they each have used the template at one or more sporting events and reported that, based on this model, the outcomes obtained were 97% consistent with their experience of earlier planning (Table 1). Interview subjects in this study, did not participate in the

Variables, Questions	% Yes	% No
1. Guidelines easy to use	100	0
2. Guidelines very useful	95	5
3. Results matched with our last year's estimation	75	25
4. Have examined similar guidelines before	75	25
5. Used this guidelines for sport events	100	0
6. The result matched up with my expectation	97	3
7. Are you going to use this guideline in your work?	85	15

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Table 1—Results of the pilot study

Sum	Scenario 4: Trot	Scenario 5: Ice Hockey	Scenario 6: Football
<20	0	0	0
21–25	0	17*	0
26–30	3	10	0
31–35	18*	0	24*
36–40	6	0	3
41–50	0	0	0
51–60	0	0	0
61–65	0	0	0
>65	0	0	0

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Table 3—Result of three sport scenarios

*Reference value: Assessed by the Prehospital and Disaster Medicine Center (PKMC) based on the estimation template

remaining survey. More than 85% of participants were going to use the template in the future if it was if available.

Survey

Step 1—All 27 participants in this survey were thoroughly informed and trained to use the original template (music) by one of our instructors. They then were tested in different non-sporting and sporting events (Tables 2 and 3).

Step 2—The participants were tested in three different non-sporting events (the National Day Celebration, a festival, and a concert to verify their abilities (Appendix 2). By summing their rating, their choices indicated the needed resources for that event (Table 2). The results then were compared with that of the reference groups (PKMC). In Scenario 1, the

Sum	Scenario 1: Swedish National Day	Scenario 2: Festival	Scenario 3: Concert
<20	0	0	0
21–25	21*	0	0
26–30	6	0	0
31–35	0	15*	0
36–40	0	12	6
41–50	0	0	21*
51–60	0	0	0
61–65	0	0	0
>65	0	0	0
Total	27	27	27

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Table 2—Results for three non-sport scenarios presented by the study group

*Reference value: Assessed by the Prehospital and Disaster Medicine Center (PKMC) based on the estimation template

majority of participants (78%) had a total of 21–25 points and a small group had a sum of 26–30 points. A higher total (chosen by the minor group) means an extra nurse in comparison to the resource chosen by the majority of participants (Table 4). For Scenario 2, two different but similar groups were formed with the sums of 31–35 points (56%) and 36–40 points (44%), respectively. Practically, by choosing the higher score, 44% of the participants doubled up the number of needed resources (not ambulances). In Scenario 3, there also was a majority (78%), who chose the sum of 41–50 points compared to a small group, who chose a sum of 36–40 points. The smaller group doubled its resource needs by having higher points.

Step 3—In this step, the results for the 27 participants on assessment of healthcare resources required at sport events were evaluated. Trot, hockey, and soccer were three sporting events with different dimensions in term of the size of arena and public. The results obtained were consistent with the outcome of the first investigation in Step 2. The most difficult scenario was Scenario 4 (trot). The totals gained in the test fell into three different score levels (Table 3). Although the majority (67%) totalled at 31–35 points, there were two smaller groups with 26–30 points (11%) and 36–40 points (22%). It can be estimated that the needed resources for this scenario (Table 4) may double in each score scale. In Scenario 5, 63% had scores of 21–25 points and the remaining 37% at 26–30 points. The difference in the number of resources needed compared to the reference group was not significantly higher. In Scenario 6, the majority of the participants (89%) had a score of 31–35. The remaining participants (11%) totaled to 36–40 points.

Sum	Ambulances*	First aid-worker†	Doctors	Nurses	Healthcare command on spot§	Reserve materials
<20	0	2	0	0–1		
21–25	1	4	0	1		
26–30	1	4	0	2		
31–35	2	12	1	2		
36–40	2	20	2	4		
41–50	2–3	40	3	6		
51–60	2–3	60	4	8	yes	yes
61–65	2–3	80	4	10	yes	yes
>65	2–3	80+	4+	12+	yes	yes

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Table 4—Sum of tables in healthcare resource estimation guideline and corresponding resource needed

*Ambulances: Staffed by two certified healthcare providers. The number of ambulances indicates the additional resources needed to reinforce the regular organization. Ambulances do not need to be on scene, but available in <10 minutes (Priority 1). If on the scene, they should have predefined tasks and be replaced if used for other tasks (not related to the event). Note also that ambulances hired by the arranger are not always full emergency ambulances.

†First Aid Workers: Staff trained and equipped to provide first aid. They might be hired from various organizations. Note that their actual medical skills may vary from none to licensed health professionals. Their qualifications and emergency skills should be defined in advance.

§Healthcare command: established on the spot.

||Reserve materials, e.g., blankets, stretchers, bandages

Evaluation of the Template in Swedish League in Football

The needed resources at four matches in the Swedish premier soccer league were calculated with the template. The estimations obtained by the model were judged by planning officers and organizers to be adequate and precise. However, the estimations for all four matches were higher than what the organizers estimated and consequently, the use of template resulted in higher costs.

Discussion

There are few studies and almost no guidelines proposing a model for estimating the healthcare resources at sporting events. The majority of published literature focuses on various factors, which influence the course of an event. Such factors might be weather, audience size, presence of alcohol, geography, and the crowd's "intention".^{12,14–33} Others discuss practical concerns at sport events, e.g., training of staff, internal and external communications, gathering areas, and post-event evaluations.^{2,26} Those documents, which come closest to some form of calculation either present a complex, theoretical model or numeric suggestions on the amount of healthcare resources required for a certain number of people in the audience and at events in general, and not specifically for sporting events.^{3,8,9} Some investigators have addressed the issue of public safety at various events based on scientific studies from the 1980s and/or earlier similar events by using statistical models. Although such a model could improve the planning and provision of healthcare resources, it incorporates much about the injury outcome at that specific event and little about the impact of public events on the healthcare.^{2,7,28,29} Some reports within the fields of public and sporting events cover the plan-

ning of healthcare organization and structure and assessment of healthcare resources needed for both participants and audience.^{30–32} Common denominators for all of these reports are their description of injury types and the difficulties of estimating and planning healthcare resources without proposing any methods for estimation of needed resources.

Since most Swedish stadiums are used for different types of events, a similar model for estimation of healthcare resources may be used (at least for events carried out on an arena or equivalent places). A guide to enhance safety at music events recently has been adopted in Sweden.¹³ The healthcare part of this guide is largely based on the UK "Purple Guide", with some modifications.^{8,9} In this study, the previously developed template was used and some minor adjustments were made to make it usable for sport events. The pilot study showed that the model was easy to use and simplified the estimation of medical resources needed during an event. However, there was a discrepancy between the outcome of current assessment and earlier estimations based on the planning officers' previous experiences. The difference was due to the absence of a clear variable for sporting events in the assessment table. Thus, another study was conducted in which a group of experienced event planning officers first were educated to use the template correctly and then, were tested by using three non-sporting scenarios to confirm their knowledge, and capability, and finally, on three sporting scenarios to evaluate the accuracy and credibility of the new template.

The results from scenarios 1–3 (non-sporting events) showed a clear division between participants' choices of healthcare resources. Although there was a clear cut majority in Scenarios 1 and 3, the overall results indicate that the major-

ity's choices were in accordance with the reference value, calculated by PKMC. Practically, the model appears to provide relatively small differences in estimated healthcare resources in non-sporting events in spite of some inter-individual variation in the interpretation of the model. The results obtained from sporting events were almost consistent with those of non-sporting events. The majority of participants chose the category group recommended by PKMC with one exception; trot scenario was the most difficult of the three different categories. Therefore, it is important to bear in mind that the results obtained by using such estimation template never should be regarded as an absolute truth regarding required medical resources, but rather a rough estimate, based on the fact that medical coverage at events can be organized in different ways, and that the most appropriate model will vary according to the medical provider and the nature of the event.⁸ It also is important to realize that the model may be easier to apply to arena-based sporting events, but can be used as a base for planning out-doors events as well, e.g., trots. The differences in size of the event were found to be important; larger events with higher numbers of people require more precise assessment, e.g., the

concert vs. hockey match in the survey (Table 4). Thus, the expected number of visitors is the single most important factor in estimating healthcare resources. Finally, the template was evaluated in four soccer matches in the Swedish premier league, in which the estimations obtained by the model were judged by planning officers and organizers to be adequate and precise. However, such estimations advocate higher level of preparedness and consequently, higher costs. The latter has been named as one major obstacle for further use of the template. On the other hand, other types of medical planning and resource estimations also have proven to be costly.¹²

Conclusions

The current template safely can be used to estimate the healthcare resources in Sweden. Although easy, its use requires some experience from previous risk assessments. However, this problem might be overcome by choosing to assess all sporting events as medium risk, as the reliability of this model nevertheless would be relatively high having 11 other parameters. It also is important to establish tight cooperation with the police and other related organizations, which also perform risk assessment at sporting events.

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Appendix 1—Healthcare resource estimations guideline (Purple guide)

Table 1 Event nature (A, B, C, D)			
A: Nature of event	Score	B: Venue	score
Classical performance	2	Indoor	1
Public exhibition	3	Stadium	2
Pop/Rock concert	5	Outdoor in confined location, eg park	2
Dance event	8	Other outdoor, eg festival	3
Agricultural/country show	2	Widespread public location in streets	4
Marine	3	Temporary outdoor structures	4
Motorcycle display	3	Includes overnight camping	5
Aviation	3		
Motor sport	4		
State occasions	2		
VIP visits/summit	3		
Music festival	3		
Bonfire/pyrotechnic display	4		
New year celebration	7		
Demonstrations/marches/political events			
*Low risk of disorder	2		
*Medium risk of disorder	5		
*High risk of disorder	7		
*Opposing factions involved	9		
A: Your choice		B: Your choice	
C: Standing/seated	Score	D: Audience profile	Score
Seated	1	Full mix, in family groups	2
Mixed	2	Full mix, not in family groups	3
Standing	3	Predominantly young adults	3
		Predominantly children and teenagers	4
		Predominantly elderly	4
		Full mix, rival factions	5
C: Your choice		D: Your choice	
Total score of table 1: A + B + C + D			
Table 2 Event intelligence (E, F)			
E: Past history	Score	F: Expected numbers	Score
*Good data, low casualty rate previously (< 1%)	-1	<1000	1
*Good data, medium casualty rate previously (1%-2%)	1	<3000	2
*Good data, high casualty rate previously (> 2%)	2	<5000	8
*First event, no data	3	<10000	12
		<20000	16
		<30000	20
		<40000	24
		<60000	28
		<80000	34
		<100000	42
		<200000	50
		<300000	58
E: Your choice		F: Your choice	
Total score of table 2: E + F			
Table 3 Sample of additional considerations (G-K)			
G: Expected queuing	Score	H: Time of year (outdoors events)	Score
Less than 4 hr	1	Summer	2
More than 4 hr	2	Autumn	1
More than 12 hr	3	Winter	2
		Spring	1
G: Your choice		H: Your choice	
I: Proximity to definitive care (nearest hospital)	Score	J: Profile of definitive care	Score
Less than 30 min by road	0	Choice of A & E departments	1
More than 30 min by road	2	Large of A & E departments	2
		Small of A & E departments	3
I: Your choice		J: Your choice	
K: Additional hazards	Score	L: Additional on-site facilities	
Carnival	1	Suturing	-2
Helicopters	1	X-ray	-2
Motor sport	1	Minor surgery	-2
Parachute display	1	Plastering	-2
Street theatre	1	Psychiatric/GP facilities	-2
K: Your choice		L: Your choice	
Total score of table 3: G + H + I + J + K + L			
Total score for tables 1 + 2 + 3			

Appendix 2—Modified healthcare resource estimation guidelines

Table 1 Event nature (A, B, C, D)

A: Nature of event	Score
Classical performance	2
Public exhibition	3
Pop/Rock concert	5
Dance event	8
Agricultural/country show	2
Marine	3
Motorcycle display	3
Aviation	3
Motor sport	4
State occasions	2
VIP visits/summit	3
Music festival	3
Bonfire/pyrotechnic display	4
New year celebration	7
Demonstrations/marches/political and sport events	
*Low risk of disorder	2
*Medium risk of disorder	5
*High risk of disorder	7
*Opposing factions involved	9

A: Your choice

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