

## Expected hazards and hospital beds in host cities of the 2014 FIFA World Cup in Brazil

Riscos esperados e leitos hospitalares nas cidades-sede da Copa do Mundo FIFA de 2014 no Brasil

Riesgos esperados y camas de hospital en ciudades anfitrionas de la Copa Mundial de la FIFA 2014 en Brasil

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### Abstract

Planning for mass gatherings involves health system preparedness based on an understanding of natural and technological hazards identified through prior risk assessment. We present the expected hazards reported by health administrators of the host cities for the 2014 FIFA World Cup in Brazil and discuss the hazards considering minimal available public hospital beds in the 12 cities at the time of the event. Four different groups of respondents were interviewed: pharmaceutical service administrators and overall health administrators at both the municipal and hospital levels. The hospital bed occupancy rate was calculated, based on the Brazilian Health Informatics Department (DATASUS). The number of surplus beds was calculated using parameters from the literature regarding surge and mass casualty needs and number of unoccupied beds. In all groups, physical injuries ranked first, followed by emerging and endemic diseases. Baseline occupancy rates were high (95%CI: 0.93-2.19) in all 12 cities. Total shortage, considering all the cities, ranged from -47,670 (for surges) to -60,569 beds (for mass casualties). The study can contribute to discussions on mass-gathering preparedness.

*Bed Occupancy; Hospital Bed Capacity; Emergency Plans*

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## Introduction

Mass gatherings are situations in which a large number of people come together for religious, sports, cultural, or political events <sup>1</sup>. In mass gatherings, healthcare must be involved throughout the health system's operational planning, which in turn must be described in a comprehensive action plan. The plan should be structured on an understanding of expected natural or technological hazards and prior needs assessment <sup>2</sup>.

Mass events may differ widely in crowd sizes, type of attendance, and nature of the event (e.g., scheduled events at sports facilities, air shows, rock concerts, outdoor celebrations, and visits by dignitaries), but may be very similar as to the need for in-place capacity and healthcare provision. Preparedness for mass events is conducted in much the same way as for disasters: emergency response based on identification of hazards. Mass events thus provide a practical opportunity to enhance the level of disaster preparedness at the local, regional, and country levels <sup>3,4</sup>.

As in disaster preparedness, the World Health Organization recommends the all-hazards approach <sup>5</sup>. Because preparedness measures are similar irrespective of the nature of the hazard, this approach has the benefits of concerted planning. The higher the level of disaster preparedness, with adequate healthcare structure and trained human resources, the less the effort needed for preparedness in mass events <sup>6</sup>, and hazard identification is a first step for government decision-making involving the health sector.

The identification of priority measures, such as defining available hospital beds and structuring response capacity should then be established in order to prepare the health sector for mass gatherings <sup>7</sup>. In several previous mass sports events such as the FIFA 2002 and 2010 World Cups and the 2004 Summer Olympic Games in Athens, Greece, calculations were made to model patient presentations and hospital transfers <sup>2,8,9,10</sup>. Yancey et al. <sup>10</sup> also proposed a 2% hospitalization rate in case of mass casualties occurring during mass events.

In Brazil, public hospitals, many of them reference centers, are at the frontline of response efforts. Under Brazilian Unified National Health System (SUS), all Brazilian and foreign citizens are eligible for hospitalization and treatment in public hospitals. Pharmacists should be very much involved in planning health needs, since they are responsible for forecasting, managing, and supplying medicines.

In 2014, 12 cities in Brazil hosted the FIFA World Cup and, in 2016, the city of Rio de Janeiro hosted the Summer Olympic Games. A comprehensive research project called *Prepara Brasil* aimed to investigate health sector and pharmaceutical services preparedness for mass gatherings in the country, specifically for the 2014 FIFA World Cup and the 2016 Summer Olympic host cities. According to Brazil's health legislation, in these "national" events, municipalities, states, and the Ministry of Health share the responsibility for coordination, thus highlighting the role of municipal and hospital administrators in operational planning and preparedness efforts <sup>1</sup>.

Our objective is to present and discuss the perceptions of health administrators in the host cities of the 2014 FIFA World Cup regarding hazards, and to compare these perceptions with available public hospital infrastructure in these cities at the time of the event.

## Method

The study was conducted in all 12 host cities of the 2014 FIFA World Cup. The cities were contacted and asked to identify three key informants: administrators from the Civil Defense Secretariat, the Health Secretariat, and the head of Pharmaceutical Services. In order to also cover hospital administrators (heads of clinical and pharmaceutical services), three hospitals were selected for visits in each city. One reference hospital was selected among the list supplied by the Ministry of Health. The first hospital that responded positively to the invitation was included. Additionally, two general hospitals with emergency care were randomly selected from the municipal inpatient facilities that fit this profile <sup>11</sup>.

Key informants were asked to respond to a semi-structured interview regarding World Cup events in Brazil, with questions related to each informant's field of expertise and a general question on hazards to be expected during the sports events.

All the administrators provided informed consent. The project was approved by Institutional Review Board of the Sergio Arouca National School of Public Health, Oswaldo Cruz Foundation (CAAE n. 17796513.6.0000.5240).

## **Hazards**

Hazards are defined as any phenomenon capable of causing damage to individuals or to the environment<sup>5</sup>. Hazards are sometimes reported together with adverse health outcomes with which they are associated. In order to investigate expectations regarding negative health outcomes associated with mass gatherings, interviewees were asked to cite “possible hazards” and “related outcomes” during mass gatherings. Outcomes were then grouped into main categories.

Data on expected hazards were collected from four groups of respondents: municipal and hospital pharmaceutical services administrators and municipal health and hospital administrators. These were additionally regrouped as all hospital administrators and as all municipal health administrators. We compared each outcome category versus all the other categories for the four different groups. Analyses between types of respondents inside each respondent group were also made.

Data were analyzed quantitatively, using descriptive statistics (frequencies). Tests of differences between proportions and Upton’s chi-square (WinPepi, 2014. <http://www.brixtonhealth.com/pepi4/windows.html>) were used to verify statistical significance at  $p < 0.05$ .

## **Availability of hospital beds for surges and mass casualties**

Data were collected on maximum capacity of FIFA 2014 World Cup arenas in each city. Surge and mass casualty calculations were carried out using this parameter. A literature review provided three possible estimates for surges in case of mass gatherings<sup>8,9,10</sup>. We chose the rates for the 2010 FIFA World Cup in South Africa (0.5/1,000), considered the closest to the Brazilian context. For mass casualties, surplus beds were calculated according to the 2% rate, calculated over maximum attendance at each sports event<sup>10</sup>.

Hospital inpatient bed availability in each host city was investigated through data available in the CNES database (National Registry of Health Establishments, 2014. <http://datasus.saude.gov.br/cadastro-nacional-de-estabelecimentos-de-saude>). The CNES base lists all health services in Brazil, classified according to level of complexity, presenting qualitative and quantitative data on services available in each facility. In each city, we only examined the institutions classified as public general hospitals in CNES levels 5, 6, 7, and 8 (more apt to provide emergency care). For each hospital, we collected the theoretical number of available beds (type and number).

In order to refine the numbers and model for hospital capacity at the time of the 2014 FIFA World Cup (in June), hospital occupancy rates for March, April, and May 2014 in each city were calculated (using hospital census data, i.e., patient-days, bed-days, and average hospital stay). Public data were obtained in December 2014 from the Brazilian Hospital Information System (SIH-SUS), through the Brazilian Health Information Department (DATASUS) database (<http://www2.datasus.gov.br/>). A 6-month gap was required to guarantee data stability (due to daily system updates that tend to wane over time), and averages were calculated. The resulting occupancy rates were applied to the theoretical availability of beds in order to obtain a proxy for actual availability. The number of unoccupied beds was calculated and subtracted from surge and mass casualty needs to obtain surplus beds.

## **Results**

Of the 12 host cities, one refused to participate, leaving a total of 33 municipal health administrators. Of the 36 hospitals that were referred for participation, 35 agreed to receive a visit from the study team. Seventy administrators were interviewed in these hospitals.

When asked about expected hazards during the 2014 FIFA World Cup, the respondents first cited adverse health outcomes and only then associated them with hazards. Four outcome categories were identified during analysis that were linked to various hazards cited by respondents: (i) physical inju-

ries, which included crushing, internal injuries, orthopedic injuries (associated with such expected hazards as alcohol abuse, violence, crowd crushes, automobile accidents, civil unrest, structural collapse); (ii) endemic infectious diseases, including malaria, dengue, tuberculosis, measles, seasonal influenza, or a surge of any prevalent infectious disease in Brazil or vaccine-controlled disease (identified as presence of the infectious agent and crowding associated with the mass gathering); (iii) emerging infectious diseases, such as pandemic influenza and other viral diseases (described by respondents as a consequence of the presence of the infectious agent imported by visitors to the games); and (iv) burns, chemical and radiation injuries and biological contamination, all of which were associated by the interviewees with chemical, biological, radiation, and nuclear incidents (CBRN).

Table 1 shows a preliminary exploratory analysis to determine differences between respondent groups. Differences emerged when we examined respondent sub-groups. Physical injuries ( $p < 0.000$ ) and endemic diseases ( $p = 0.001$ ) were mentioned more frequently by pharmaceutical services administrators in hospitals than by their peers in municipal services. Among health administrators, physical injuries ( $p < 0.000$ ) and emerging infectious diseases ( $p = 0.007$ ) were much more likely to be mentioned by hospital directors than by municipal health administrators. Pharmaceutical services administrators in hospitals differed from hospital directors in relation to endemic infectious diseases ( $p = 0.001$ ). Municipal administrators (health and pharmaceutical services) differed in relation to physical injuries ( $p = 0.013$ ). Hospital directors were concerned about physical injuries and emerging diseases, while hospital pharmaceutical administrators also focused on physical injuries, but on endemic rather than emerging diseases. Regarding total number of responses in all groups, physical injuries ranked first, followed by emerging diseases and endemic diseases. Few respondents cited CBRN incidents.

Table 2 shows the results for availability of beds during surges and mass casualties in public general hospitals only. Baseline occupancy rates were very high (0.93-2.19) in all the cities. This resulted in mostly negative theoretical availability of beds at baseline. The last two columns show total numbers of beds available during surges (764 to -17,191). Only one host city (J) showed theoretical availability for surges. Municipality K showed the largest deficit for surges. In case of mass casualties, the shortages were even greater. All host cities showed hospital bed deficits (-328 to -18,693). Total deficits, in all the cities, ranged from -47,670 (for surges) to -60,569 beds (for mass casualties).

## Discussion

The article presents expected hazards and outcomes reported by municipal health administrators, hospital directors, and municipal and hospital pharmaceutical services administrators in the 2014 FIFA World Cup host cities in Brazil. The analysis aimed to estimate the actual availability of public hospital beds to respond to mass casualties, had these hazards materialized. We also analyzed surges, or the baseline demand in case of mass gatherings.

We proposed a simplified estimate of response capacity, given hazards reported by administrators, based on maximum crowd capacity at each sports venue. We also worked with the independent occurrence of mass casualties, in light of the distance between venues and the diverse settings. Lastly, we assumed that calculations for surges and mass casualties would be based on maximum capacity rather than on actual attendance. However, given that nearly 3 million tickets were sold for 2014 FIFA World Cup, an estimated 6,000 people would have made some kind of contact with healthcare services<sup>10,11</sup>.

Comparisons of responses to hazards were done for sub-groups only. Reporting of expected hazards by administrators in different settings account for their perceptions of how such hazards would impact healthcare provision. Most hospital administrators were worried about trauma, expressed as physical injuries. If one of the hazards they cited (alcohol abuse, civil unrest, outbreaks of violence, motor vehicle accidents, crowd crushes, structural collapses) had occurred, they would have needed emergency health services such as hospital transportation, beds, dialysis, and trauma diagnostic centers to mitigate the consequences<sup>12</sup>. However, by examining the results for available beds, we find that they would be insufficient to accommodate trauma patients. Apart from physical injuries, hospital directors also mentioned emerging infectious diseases, revealing their awareness of possible consequences of mass gatherings and strain on hospital services.

**Table 1**

Respondents in different sub-groups and frequencies of outcome categories. *Prepara Brasil*, 2015.

Respondent group	n	Outcomes							
		Physical injuries	%	Endemic diseases	%	Emerging diseases	%	CBRN	%
(All) Pharmaceutical service administrators									
Municipal	11	6	13 *	2	4 *	7	15	2	4
Hospital	35	23	50 *	15	33 *	9	20	1	2
Total	46	29	63	17	37	16	35	3	7
(All) health administrators									
Municipal health administrators	11	11	24 *	2	4	5	11 *	5	11
Hospital directors	35	29	63 *	3	7	16	35 *	4	9
Total	46	40	87	5	11	21	46	9	20
(All) hospital administrators									
Pharmaceutical service administrators	35	23	50	15	33 *	9	20	1	2
Hospital directors	35	29	63	3	7 *	16	35	4	9
Total	70	52	74	18	26	25	36	5	7
(All) municipal health administrators									
Pharmaceutical service administrators	11	6	13 *	2	4	7	15	2	4
Municipal health administrators	11	11	24 *	2	4	5	11	5	11
Total	22	17	77	4	18	12	55	7	32

CBRN: chemical, biological, radiation, and nuclear incidents.

\* p < 0.05.

**Table 2**

Availability of public hospital beds for surge and mass casualties in 2014 FIFA World Cup host cities. *Prepara Brasil*, 2015.

Host city code	Available beds in public general hospitals *	Occupancy rate	Occupied beds	Available beds **	Transport to hospital in surge (0.5/1,000) ***	Hospital admissions in mass casualties (20/1,000) ***	Deficit or surplus beds during surge	Bed deficit for mass casualties
A	6,122	1.94	11,878	-5,756	31	1,251	-5,787	-7,007
B	2,226	1.34	2,974	-748	35	1,400	-783	-2,148
C	1,411	2.19	3,090	-1,679	21	859	-1,701	-2,539
D	3,408	2.16	7,361	-3,953	21	820	-3,973	-4,773
E	5,790	1.68	9,735	-3,945	33	1,300	-3,978	-5,245
F	2,794	1.89	5,275	-2,481	22	880	-2,503	-3,361
G	2,371	1.51	3,590	-1,219	21	840	-1,240	-2,059
H	5,286	1.43	7,565	-2,279	25	1,000	-2,304	-3,279
I	6,985	1.78	12,460	-5,475	23	920	-5,498	-6,395
J	11,996	0.93	11,204	792	28	1,120	764	-328
L	6,156	1.56	9,599	-3,443	33	1,300	-3,476	-4,743
K	16,808	2.02	33,961	-17,153	39	1,540	-17,191	-18,693
<b>Total</b>							-47,670	-60,569

\* National Registry of Health Establishments, 2014 (<http://datasus.saude.gov.br/cadastro-nacional-de-estabelecimentos-de-saude>).

\*\* Theoretical.

\*\*\* Yancey et al. 10.

Note: maximum arena capacity ranged from 41,000 to 77,000 spect.

Municipal and hospital pharmaceutical administrators were much more concerned about endemic infectious diseases, perhaps because of the obvious association with ongoing availability and use of medicines (antimicrobials). However, hospital pharmacists reported more expected hazards than did municipal pharmacy administrators. Hospital pharmacists may feel more direct pressure on the pharmaceutical supply, given the present state of antimicrobial resistance in Brazil<sup>13</sup> and difficulties in procurement and supply in the public sector<sup>14</sup>.

The data show a staggering deficit of public hospital beds in host cities in Brazil, due mostly to huge baseline occupancy rates. Only one city showed occupancy below 100%. The public hospital system thus already functions above capacity. Especially in case of mass casualties, additional response capacity (in this case surplus beds) could be very difficult to achieve. However, other possibilities for accommodating response could be devised in emergency situations. Hospital administrators cited cancellation of elective surgeries, activation of empty or underutilized rooms, partnerships with the private sector, and field hospitals (11). The Brazilian Ministry of Health assigned more than 1,500 extra beds to the 12 cities. If a hazardous event had materialized, other response mechanisms would have had to be implemented on an emergency basis<sup>15</sup>.

The results also showed little or no planning for surge. Surplus beds were only available for surges in one host city (J). This is a natural and predictable situation<sup>2,3,10,16</sup>. Surges could result from food poisoning or related gastrointestinal problems, high blood pressure (common in high-stress competitive sports events), heat stroke, and alcohol abuse, among others. Administrators only cited alcohol abuse, which they associated with trauma and physical injury. It is reasonable to believe that surges occurred during the 2014 FIFA World Cup. Some accommodation must have occurred in private hospitals, given the unavailability of beds in public hospitals, but we found no records in the literature on surges during the 2014 FIFA World Cup.

We assumed that the calculations would adequately estimate what really happened. However, according to the literature<sup>2,17,18</sup>, demand is modulated by weather conditions, event types and boundaries, crowd mobility and mood, density, demographics, and alcohol and drug use. Although the FIFA World Cup draws huge crowds in happy or angry moods that may also use alcohol and drugs, no untoward events happened to indicate that these conditions were prevalent during the 2014 World Cup. Moreover, our calculations for surge were based on an empirical study in South Africa<sup>10</sup>, which may have overestimated the actual demand in Brazil. Historical data might have been more adequate, but to our knowledge they were unavailable<sup>9</sup>. Additionally, although surplus resources are necessary, there is some controversy as to the level of resources actually needed. The literature highlights that most health needs during mass events involve mild cases, and only minimal medical intervention is required<sup>19</sup>. The most common needs are related to lacerations, dehydration, and falls<sup>20</sup>. Only a small percentage of patients are referred to hospitals<sup>21</sup>. Resource allocation for health needs during mass events should thus be carefully planned by organizers. In Brazil, considering the prospects for more mass events in the future, planning should include availability of on-site health services, based on all of the above.

National inpatient data in Brazil tend to change over time due to progressive validation of health system reimbursement fees (DATASUS. Internações hospitalares. <http://www2.datasus.gov.br/DATASUS/index.php?area=2&id=697&assunto=2939>). However, even if average occupancy rates were calculated 6 months after actual admissions, residual changes may have occurred after the data were collected. For example, our estimates did not take into account that additional strain can be caused simply by intense turnover or by “stacking” of surge, i.e., if an inpatient admitted during the first sports event is not discharged before another patient is admitted later. Likewise, we did not take into account that in more complex models, patient presentation rates increase where access to health services is difficult<sup>8</sup>, since we did not measure access or transportation.

The delivery of emergency medical care is a function of a series of structural and operational components, centrally dependent on a medical action plan<sup>22</sup> in which hospital structure and availability must be considered. Moreover, preventive and therapeutic resources must be positioned in relation to expected health outcomes in order to address surge demand and mass casualty situations<sup>10</sup>.

A commitment of the study protocol was to maintain confidentiality as to host cities' names, which might otherwise identify respondents. Cities differed considerably as to local organization, distribution of urban equipment, transportation, and health resources, which surely affected response



capacity. However, a further limitation to the study lies in acknowledging these factors while not being able to discuss them according to each individual host city.

The UK Health Protection Agency (HPA) was intensely involved in planning for the 2012 Summer Olympic Games in London and worked to upgrade health systems and processes. The Agency also strived to make health surveillance data available and to disseminate awareness of possible hazards and related risks<sup>23</sup>. In Brazil, shortly before the 2014 FIFA World Cup the Ministry of Health published a statement in a Ministry-sponsored journal to disseminate information on health preparedness. Administrators interviewed in all host cities were not uniformly aware of government efforts or of their roles in response<sup>11</sup>.

## Final remarks

The article presented and discussed expected hazards and availability of hospital beds for surges and mass casualties during the 2014 FIFA World Cup in the 12 Brazilian host cities. We recognized the inherent limitations of using secondary data to calculate occupancy rates and the choice of a theoretical model from the literature based on estimations for surges and mass casualties.

There was a widespread shortage of hospital beds in all 12 cities. If hazards had actually materialized as events, the public hospital network in the host cities would have had to work above capacity. Surges must have been partially accommodated by the health system, but shortage of beds is an important constraint in public hospitals and must be considered in planning future mass events in Brazil.

In Brazil, mass gatherings occur every year or have occurred recently, some drawing many more people than the 2014 FIFA World Cup. Examples include Carnival, the New Year's Celebration on Copacabana Beach in Rio de Janeiro, World Youth Day in 2013, and religious celebrations in many cities. Such mass events have not resulted in mass casualties thus far. However, no historical data have been published to help estimate health needs during future events. Our research, although limited, may be useful in identifying and discussing important issues related to surges and mass casualties, thereby contributing to preparedness for mass gatherings.

## Contributors

E. S. Miranda participated in the research project conception and coordination, methodological development, data analysis, and writing and revision of the manuscript. K. Shoaf participated in the methodological development, data analysis, and revision of the manuscript. R. S. Silva participated in the data collection and analysis for the manuscript. C. F. Freitas participated in the project's data collection and analysis. C. G. S. Osorio-de-Castro participated in the research project conception and coordination, methodological development, data analysis, and writing and revision of the manuscript. All authors approved the final version to be published.

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## Resumo

O planejamento de megaeventos envolve a preparação do sistema de saúde, com base na compreensão dos perigos naturais e tecnológicos, através da avaliação antecipada dos riscos. Os autores apresentam os riscos esperados relatados pelos gestores da saúde das cidades-sede durante a Copa do Mundo FIFA de 2014 no Brasil e discutem os riscos com base na disponibilidade mínima de leitos hospitalares públicos nas 12 cidades na época do evento. Quatro grupos foram entrevistados: gestores de serviços farmacêuticos e gestores gerais da saúde, ambos nos níveis municipal e hospitalar. Foi calculada a taxa de ocupação dos leitos hospitalares com base em dados do Departamento de Informática do Sistema Único de Saúde (DATASUS). O excedente de leitos foi calculado, utilizando parâmetros da literatura sobre picos de demanda (surges) e acidentes com múltiplas vítimas e o número de leitos desocupados. Em todos os grupos, as causas externas ocuparam o primeiro lugar, seguido pelas doenças emergentes e endêmicas. Todas as 12 cidades já apresentavam taxas de ocupação altas (IC95%: 0,93-2,19). O déficit total de leitos, considerando todas as cidades, variava de -47.670 (para picos de demanda) até -60.569 leitos (para acidentes com múltiplas vítimas). O estudo pode subsidiar as discussões sobre o preparo para megaeventos.

Ocupação de Leitos; Número de Leitos em Hospital; Planos de Emergência

## Resumen

Planificar eventos para masas de gente implica la preparación del sistema de salud, basada en una comprensión de los riesgos naturales y tecnológicos, que hayan sido identificados previamente tras una evaluación de riesgos. Presentamos los riesgos esperados que fueron informados por los gestores de salud en las ciudades brasileñas anfitrionas de la Copa Mundial de la FIFA, y los discutimos, considerando el número mínimo disponible de camas en hospitales públicos en 12 ciudades, durante el evento deportivo. Hubo cuatro grupos diferentes de entrevistados: gestores del servicio farmacéutico y, en general, distintos gestores de salud en ambos niveles: municipal y hospitalario. La ratio de ocupación de camas se calculó basándose en el Sistema de Información del Sistema Único de Salud (DATASUS). El número de camas sobrantes fue calculado usando parámetros de la literatura, concierne a las necesidades surgidas, número de víctimas y número de camas desocupadas. En todos los grupos, las lesiones físicas se encontraban en primera posición, seguidas de las enfermedades emergentes y endémicas. Las ratios base de referencia de ocupación fueron altas (IC95%: 0,93-2,19) en las 12 ciudades. La escasez total, considerando todas las ciudades, oscila desde -47.670 (para incrementos) a -60.569 camas (para víctimas en masa). El estudio puede contribuir a discusiones sobre la preparación de eventos para muchedumbres.

Ocupación de Camas; Capacidad de Camas en Hospitales; Planes de Emergencia

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