Toolbox for Implementation of Surveillance at Mass Gatherings

WP 4: Surveillance during Mass Gatherings

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1 Introduction

Public health approaches to mass gatherings (MGs) are relatively new. Medical interest in MGs started most probably in early seventies in connection with potential substance abuse and injuries at music festivals (1, 2). Later on more emphasis was put on medical threats and on preparation and organization of medical services at those festivals (3-5).

Expectations of increased incidence of health problems in other types of mass gatherings were considered later. Franaszek hypothesized in his editorial note “Medical care at mass gatherings”, published in 1986 (6), that the number of health problems among participants at MGs should be higher than that expected in the same populations not gathered at these events. In oncoming years more evidence was collected on incidence in different categories of health problems and on potential types of exposures associated with disease incidence at mass gatherings. Since the Olympic Games in 1984 in Los Angeles enhanced surveillance was gradually introduced and upgraded in increasing fraction for major international sport events (7).

Since then vast literature was accumulated on the subject of different types of health risk associated with mass gatherings including risks related to e.g. infectious diseases. Numerous elaborations and instructions have been issued by local and national departments of health, international organizations including WHO, scientific bodies like CDC and ECDC but also non-governmental groups like EpiConcept.

Public health measures undertaken at MGs or indicated to be taken can be divided into a set of tools to be used on different stages of preparation: before the event, at the time it takes place and immediately afterwards. Specific recommendations in this respect differ in details and in distribution of priorities, but those more developed usually include the following:

- List of potential hazards, their definitions and pre-event risks assessment
- Suggested elements in the preparation to disease prevention and control at the event
- Evaluation of preparation to the event with special reference to the public health measures
- Ongoing evaluation of the effectiveness of public health measures during the event
- Final analysis and evaluation of public health measures after the event.

All these listed points can be divided into smaller sections, analyzed and processed separately with tools fitting to the particular problem. Some of the written materials on the subject of public health measures at mass gatherings provide extensive and comprehensive material on the subject, being adaptable to almost any planned mass gathering in advance. Though the problem remains with the variety of different types of mass gatherings, differences in local conditions and circumstances preclude itself a sufficient fitting of generic tools to many individual events. Although those universal tools provide a basic framework for public health preparation to MGs, their proper use to particular events requires special adjustment.

The purpose of the WP4 of the REACT project is to find ways to adapt and implement more universal recommendations regarding surveillance of infectious diseases and their preven-
ation at mass gatherings according to the local infrastructure, available personnel and re-

2 Evidence base - Data sources for preparation of tools for preparation and implementa-
tion of enhanced surveillance system at mass gatherings

To obtain comprehensive insight into gained experience and knowledge regarding surveil-
lance of infectious diseases at mass gatherings several data sources were used:

- structured literature review;
- structured checklist review;
- personal information on expert experience regarding surveillance system at MGs;
- review of existing documents by national or international institutions.

This wide approach was used in order to get not only a wide coverage of the general knowl-
edge on the subject, but also to include personal opinions of experts who already partici-
pated in the preparation and application of surveillance of infectious diseases at mass gath-
erings.

With such a variety of source documents some redundancies are inevitable; therefore el-
ements included more frequently in analyzed materials indicate priorities.

Besides published scientific articles another important approach of many authors is the use
of checklists. These should guide organizers to set up the event and authorities to supervise
the readiness of organizers for proper preparation of the event. We also looked for practica-
ble applications of checklist to assess existing or planned surveillance systems. We per-
formed for the checklists found in the literature review a structured analysis of their applica-
tion and contents.

A special set of questions concerning personal experience in epidemiological surveillance at
MGs was delivered to a group of experts participating in infectious diseases surveillance at
major sporting events or other mass gatherings in Europe and Australia. We did telephone
interviews in the following way: we were seeking advice from more experienced colleagues
and were always requesting an assessment of values of particular types of surveillance and
measures. This same questionnaire using open questions was sent to a set of experts who
attended WHO meeting Global Forum on Mass Gatherings in Rome in October 26-29, 2009
in order to obtain written responses. A joint analysis of both sets as well as individual re-
sponses is included in chapter 2.3 of this document.

A special session of expert consultations was prepared for REACT plenary meeting in Warsaw
in June 15-17. Experts were informed about the plans, procedures and results obtained for
WP4 and were asked of their opinion regarding tentative findings and conclusions. Their
opinions on the assumptions and design of the project were also considered.

Important comprehensive documents of WHO and Emergency Management Australia are
included as references for a generic approach to public health assessment at MGs. Building
on such background information we tried to prepare local adjustment of epidemiological
surveillance and preventive measures regarding infrastructure, resources and workforce in
place.

2.1 Structured literature review
2.1.1 Method

Literature review was performed through different stages. First, a broad set of publications on mass gatherings was collected using different search engines (PubMed, Cochrane database, Google). A set of 355 selected hits concerning public health problems and epidemiological surveillance at mass gatherings were found and further investigated. For selected publications reporting public health activity at sporting events or other mass gatherings structured review of the type of surveillance and preventive measures was done.

2.1.2 Results

Ninety-eight publications were included in the structured analysis of literature content (whole bibliography annexed as Microsoft Excel file: “Matrix literature.xls”). Criteria for selection of those publications directly targeted those concerning public health analysis of mass gathering events.

80 of those publications were found in peer-reviewed scientific journals, 18 were not strictly scientific. They were published by administrative bodies, international organizations or NGO’s. 80 of all 98 publications covered one mass gathering event, 17 more than one. 69 events were related to sporting tournaments, seven to religious meetings, four to musical festivals. The remaining 18 dealt with other types of events. 80 events were international, 18 limited to one country or state. 21 were performed at one place, 77 at more than one venue.

25 publications included reports about outbreak investigation. In the remaining 73 articles no outbreak of infectious diseases was reported.

Reference to surveillance system used at those gatherings was found in 70 of those reports; in 19 events it was routine surveillance, in 43 routine surveillance with some enhancement concerning improvement of timeliness, use of other routine data sources or technological improvement. Only in eight cases surveillance systems were especially adopted for mass gatherings: diseases or syndromes were included that were not reported in routine surveillance or special computerized reporting system were employed.

In most cases of reviewed surveillance systems reporting was limited to reporting of cases. Only in 14 surveillance systems incidence of infectious diseases was calculated. Detailed characteristics of the surveillance systems used in particular mass gatherings is shown in the literature matrix and in published commented reviews of literature.

Extensive review of medical literature reporting health problems at mass gathering events prior to the year 2001 provides a publication of A.M. Milsten and colleagues (8). Most of the studies collected in this review had rather descriptive character lacking deeper epidemiological analysis. In some of those events information on health problems was based on anecdotal case reports, in other on retrospective chart reviews.

Literature review regarding application of different types of checklists at mass gatherings is provided in the article “Structured Sanitary Preparation To Mass Gatherings” by Zieliński and Gladysz (9). Comprehensive checklists are present in publications by El Omeiri and colleagues (10) and by Northwest Center for Public Health Practice at University of Washington (11).
2.1.3 Results and Discussion: Important Points

Defining mass gatherings by the number of participants causes serious methodological difficulties. The same number of people gathered in different areas brings different problems depending on type of event, infrastructure, preparedness, and background density of the population on which mass gathering is superimposed. The WHO document “Communicable disease alert and response for mass gatherings” defines threshold for MGs as low as 1000, but recommends as generally accepted numbers of more than 25,000 people gathered at a specific location for a specific purpose for defined period of time (12).

The basic distinction regarding MGs is whether they are planned or not. The impact of MGs is profoundly influenced by their purpose, number of participants, their demographic structure, local development of infrastructure, resources and preparedness of services if the event was planned (13).

Because of mass gatherings which occur at planned sport and other social events organizers face the whole spectrum of problems and challenges related to the logistics of the event, but also to security and safety of participants and non-participating permanent dwellers of the place or region where those events occur (12-15).

Infectious diseases are not the only health hazards which may happen at mass gatherings, but they are among important threats. Potential sources of infections are related to close proximity of participants at the events enhancing the spread of airborne infections. Large numbers of people using restaurants or food vendors increase the possibility of food-borne outbreaks. Some MGs facilitate social encounters resulting in STI or infections related to IVDU. Deliberate release of infectious agents also has to be taken into account as a potential treat. Estimating the probability of such an event is difficult, the severity unpredictable (16, 17).

2.1.3.1 Practice and rationale behind enhanced surveillance at mass gatherings

As it was mentioned above, in the last decades enhanced surveillance of infectious diseases was implemented in some of the mass gatherings at sport or religious events. Despite wide recognition of the importance of early and highly sensitive detection of health events at mass gatherings, specially implemented syndromic surveillance systems (SSS) are relatively rarely applied, although fraction of mass gatherings with such systems increases.

In their comprehensive assessment Sniegoski and colleagues compared systems of enhanced surveillance applied at different sport events: Summer Olympics, Winter Olympics, and World Cup (soccer) since 1984 up to 2007. Out of six Summer Olympics syndromic surveillance was applied in 1984 Games in Los Angeles (California), in 2000 Sydney and in Athens in 2004. In Winter Olympics syndromic surveillance was used in Salt Lake City (Utah) and in Torino (Italy). Regarding World Cup (soccer), syndromic surveillance was implemented in 2002 in Korea and Japan (7, 18-25).

Enhanced reporting of diseases and syndromes by phone three times per week was the essence of the system employed at Los Angeles (1984) Olympic Games (26). In 1992 Summer Olympics in Barcelona routine reporting was upgraded by adding diseases and increase of frequency of reporting (27). In 1996 in Atlanta laboratory reporting was augmented. An additional surveillance system for Olympic clinics (7) was also on place. In the 1998 World Cup in France “activated” reporting of modifiable diseases was used. A computer system to analyze data and produce reports was also created (21). In 2000 Summer Olympics and Paralympic Games in Sydney, augmented reporting was introduced. It was supplemented by...
sentinel surveillance organized by Epidemiology Department for Olympic clinics, cruise vessels, food safety, environmental health and global epidemiological news (28). For 2002 Winter Olympics in Salt Lake City system ALERT was created and also drop-in RODS, real time outbreak and disease surveillance system, was installed. During World Cup in Japan for syndromic surveillance a web-based national Emergency Medical Info System (29) was used. In 2004 Summer Olympics and Para-Olympic Games in Athens cases of infectious diseases were reported daily. Syndromic surveillance of hospital outpatients, athletic venues and cruise ships was also implemented. This system required high operational effort since most of the work was done manually (7, 19). At Winter Olympics in Torino augmented system was implemented for selected diseases, labs and also toxic exposures, which were reported with increased frequency. Syndromic surveillance was also introduced and coded manually (7, 22). During 2006 World Cup in Germany augmented reporting was performed by means of SurvNet web system with increased frequency. Daily summary reports were obtained from local health departments. An additional free text reporting system was also introduced for relevant public health events, as it was defined by local health departments. In parallel continuous monitoring of domestic and international media was implemented for epidemiological events. German system was remarkable for domestic and international spread of publicly available data and information (30-32). During Euro 2004 in Northern Health Region of Portugal health events were reported on daily basis by phone or e-mail by physicians: foodborne outbreaks, legionnaire’s disease, meningococcal disease, acute flaccid paralysis, diphtheria, measles, and unexpected adverse health events. Enhanced surveillance in Austria did not include syndromic surveillance. It was based on enhanced surveillance by health authorities and the food safety sector. The reports on outbreaks and special events were sent daily. In addition the reference laboratories reported daily on potential clusters of confirmed cases (34, 35).

Terrorist attacks on World Trade Centre in New York were a turning point for security measures in sport events, especially in the USA. In 2001 enhanced surveillance was implemented in Super Bowl (American football league semi-finals and final). All seven annual Super Bowls between 2001 and 2007 had enhanced surveillance, but syndromic surveillance was implemented in three of them: Tampa (Florida) 2001, Jacksonville (Florida) 2005 and Miami (Florida) 2007. For Super Bowl in Tampa the special computerized surveillance system STARS was created, for Jacksonville BioDefend and in Miami ESSENCE. Novel solutions in 2007 Super Bowl were the inclusion of zip codes into data resulting in automatically performed territorial and age grouping (7).

More profound insight into interdependencies between circumstances and health outcomes may lead to models that better prioritize environmental and behavioural factors functioning in mass gathering setting. This would allow for more effective interventions. Important attempts in this direction were done in a series of papers by Paul Andrew Arbon who tried to develop conceptual models for mass gathering health (17, 36-39). In order to obtain comparability of different studies he started with defining basic measures of reported incidence: patient presentation rates (PPR), transport to hospital rate (TTHR). Then he attempted to classify key characteristics with potential effect on PPR, such as: size and duration of the event, weather, exposure of participants (indoor vs. outdoor events), general type of the event, mobility and emotions of the crowd, type of terrain, demography (distribution of age and gender), availability of alcohol and drugs. His preliminary model divided the key characteristics of mass gathering events into three inter-related domains: biomedical, psychosocial and environmental. He believed that his models may help to understand epidemiology of mass gatherings, encourage further research and “to facilitate the development of knowledge base that we apply into practice”. The question remains how realistic is such a pro-
gram. Due to a number of different factors, the variability within each of them and between different mass gatherings even the most meticulous analyses of past events may offer only crude estimations of variables to be measured in future ones. Nevertheless past experience, even imperfect as it is, provides a framework of rational predictions to plan events and to formulate guidelines and checklists for preparation of oncoming event. Also some standardization of registered variables is worth consideration in order to make studies more comparable.

Implementation of enhanced surveillance during mass gatherings brings several theoretical questions regarding its purpose, need, and needed extent. Also technical questions are of big importance. They concern size of the event, place where it occurs, locally existing infrastructure (especially medical and epidemiological services including surveillance system), its technical organization (e.g. available staff) and technical equipment. Climate, season, and weather are important variables as well (17).

If enhanced surveillance is being considered, cost of its implementation and operational effort should be also analyzed (40).

### 2.1.3.2 The purpose of enhanced surveillance at mass gatherings

Early publications indicating an increase of adverse health events during mass gatherings are in accordance with intuitive insight into the circumstances known as potential risk factors of infections, injuries, cardiovascular incidents and other adverse health reactions (6). Learnt assessment of those risks is essential for focusing attention on certain groups of participants or permanent dwellers, for planning extra services, mobilization and training of personnel as well as for estimation of extra costs. Expectations are that enhanced surveillance may provide more accurate data on the disease burden related to mass gatherings (41-46).

Another rationale for enhanced surveillance is to directly find cases, which may need medical assistance, and to discover outbreaks, which require full work up including administrative decisions (3, 47-49).

One of the most important tasks in planning enhanced surveillance at mass gathering is the preparation for a bioterrorist attack. It requires preparation of special measures, which would assure early detection and could minimize potential effects of deliberate release of infectious agents. These may have unusual characteristics for the place and population, may have unpredictable properties in terms of virulence and drug resistance, and may be released in a way different from well known patterns of diseases spread (42, 50).

### 2.1.3.3 The reliability

Regarding enhanced surveillance at mass gatherings the question remains how reliable is the obtained information that observes an increased incidence at those events. In other words: what fraction of reported cases is attributable to an increased incidence and what fraction is related to an increased sensitivity of the surveillance due to increased commitment of people involved in reporting or introduction of new reporting tools, like sentinel posts of syndromic surveillance systems. The quality of the basic surveillance system in a particular place is also important in assessing detecting algorithms. With an efficient local system in place some enhanced surveillance algorithms may not provide any additional value e.g. for detection of outbreaks (51).

Reliable comparison of data on local epidemiological conditions obtained during routine and enhanced surveillance would require the implementation of enhanced surveillance in the
same place when there would be no mass gathering. Seasonal or annual fluctuation should be taken into account as potential effect modifying factors. So far, such an assessment of epidemiological background based on enhanced surveillance out of the event was rarely done (52).

2.1.3.4 Another problem is related to the age and gender distribution of cases that can differ between the pre-event and the event-based population. Evaluation of previous efforts of enhanced surveillance

A good example of structured evaluation of enhanced surveillance at mass gatherings was prepared by Lombardo and colleagues (53). In the part on risk of infectious diseases these authors first analyzed primary aspects of mass event; i.e. increase of the population, population density and movement. As factors related to the risk of infections connected to the size of the population they listed an increase of the absolute number of initial cases, frequency of interpersonal contacts and increased proximity of those contacts. It would be advisable to estimate the relative importance of those factors in the process of prioritizing the analyzed events.

Another important aspect depends on population movement and on contacts between population groups: exposure of locals to visitors, exposure of visitors to locals. As secondary aspects Lombardo and colleagues list behaviours and customs of participants, new services, breakdowns in infrastructure and finally the potential for terrorist attacks.

Those authors suggest to start with the evaluation of the effort required for setting up and maintaining the surveillance system. Setup efforts depend on projected expectations regarding coverage, sensitivity, timeliness and data quality as well as on the existing surveillance system on which enhancement will be superimposed.

Operational efforts depend mostly on the following: information structure of the system, extent of automatic procedures, its elasticity and simplicity and obviously on the professional skills of the personnel. Electronic systems generally require less operational efforts than paper-based ones, but they set higher requirements to the personnel operating the system. Implementation of any new additional surveillance system (e.g. sentinel, syndromic) that was not operating before the event increases both setup and operational effort.

The next important aspect in evaluation concerns sharing results. What is shared: data or information or both? Is it raw data or already structured? With whom is it shared? How wide is the sharing: within local jurisdiction or inter-jurisdictionally? Is information available publicly, or is it shared within administrative authorities (7)?

Within any structure, quality of surveillance depends on proper choice of variables to be reported. Clear and well documented methodology for prioritization was provided by a group of authors from Robert Koch-Institute in Germany, who introduced a specially designed three tiered scoring system. With use of weights representing local specificity and characteristics of the event those criteria are well applicable to choose priorities for enhanced surveillance in mass gatherings (54).

2.1.3.5 Measurement of the local preparedness to the event

Enhanced surveillance is one of many aspects of local preparedness to the event. Other aspects are related to existing material resources and infrastructure, availability of human personnel, and its professional education, training targeted for the purpose and if possible ex-
perience in participating in the previous events of similar type. Numerous sources provide extensive description of elements needed for the effective preparation to mass gatherings with all possible areas of importance (8, 12, 13, 53, 55, 56): legal base, safety and security, transportation and traffic regulation, accommodation, food supply, media, communication, and many areas of public health including infrastructure and preparation of health services (like surveillance of infectious diseases and of other adverse health events).

The simplest way to evaluate preparedness to the event would be to use one of numerous available checklists step by step. Such an approach would be highly insufficient because adapting general rules to a particular event is the most difficult task in assessing the preparation for an event. The following should be explicitly taken into consideration:

- estimated size,
- expected demography,
- duration of the event,
- crowd density and mobility,
- local health and hygienic problems,
- hygienic customs of the visitors,
- epidemiology of infectious diseases in the country (and county) of event, and in the home countries of visitors.

Special attention is required to indicate which points of the chosen checklist have universal character, which should be adjusted to the event and hosting country (or countries), and which could be omitted in certain particular events. It would be also very useful to introduce criteria for grading importance of points to be checked as well as of obtained responses.

With limited resources prioritization of problems related to the preparation of the events on local and national levels, is crucial for the rational planning of the budget (13, 57).

2.1.3.6 Syndromic surveillance – solution and a problem

In routine surveillance of infectious diseases the identification of the agent is of crucial value. It finally confirms clinical diagnosis and provides basis for treatment, narrows possibilities of transmission and points to potential sources. But identification of the agent requires an involvement of laboratory and more time then direct reporting of signs and symptoms which could be particularly important in some circumstances. The term “syndrome” has a different meaning in the context of syndromic surveillance than in clinical use. It is based on a few items or even a single one from a short list of signs or symptoms, which are characteristic for the disease or group of diseases of particular interests. Such “particular interest” emerges from outbreak potential (for example diarrhoea with vomiting) or seriousness of the disease (e.g. meningitis or encephalitis). In any case public fears and media interests should be taken into consideration, but never as a sole criterion (7, 39).

In a broader sense syndromic surveillance also includes surrogate indicators of illness such as medicines purchases which reflect the appearance of prodromes of diseases before full blown symptoms occur. Different indicators reflect different points of time regarding stage of infection. Therefore, they also have different sensitivities. In general, the earliest reporting usually occurs from school or work absenteeism, then over-the-counter drug sales, consultations of general practitioners, emergency transportation or emergency room notifica-
tions. Systems which use multiple sources of reporting should rather analyze them separately to avoid confusing data and duplicate records (58, 59).

Evaluations of existing syndromic surveillance systems highlight problems with poor timeliness and low level of acceptance. Especially the reporting stage poses this problem, whereas further processing shows good timeliness. Acceptance and timeliness are particularly poor when reporting is not done by public health professionals.

Most of the systems used for syndromic surveillance, including those designed for MGs, focus on signs and symptoms of diseases being reported in routine surveillance like flu-like symptoms or having bioterrorist potential. These systems were tested in special simulation exercises and even in real mass gatherings. Tests during real terrorist attacks were performed extremely rarely, if ever. Some of them include quite sophisticated statistical packages with algorithms aiming to detect outbreaks adjusting incidence for seasonal variations.

Stoto and colleagues performed a modelling exercise to assess conditions under which syndromic surveillance is effective and to grade effectiveness of different algorithms. They compared four different schemes of syndromic surveillance for detection flu-like symptoms. The first scheme used daily reporting of cases, the second a moving average with increased weight for recent cases, the third cumulative deviation from the constant expected value and the fourth cumulative deviation from the constant expected value which was adjusted for seasonal variation. According to Stoto and colleagues, those more elaborated algorithms are needed to secure sufficient sensitivity for detection of small outbreaks or early detection of bigger ones. Large outbreaks can be quite easily detected by almost any of the systems (60).

In a systematic description of evaluation for syndromic surveillance Chapman and colleagues highlight three crucial stages: technical accuracy, case classification and outbreak detection. In technical accuracy the questions is asked: “Does the system what it is trained to do?”. Regarding case classification they stress the importance of diagnostic quality of chief complaint classifier and chief complaint content. For outbreak detection they analyze accuracy and timeliness. This task is the most difficult since outbreaks are rare. Therefore, limited material for analysis is available (61).

It is obvious that the detection of a small excess of cases with flu-like symptoms is crucial in case of a bioterrorist attack with an agent that starts with those symptoms. But such a small excess has minor public health importance due to many seasonal viral infections. In order to ensure prompt confirmation of those excessive cases and to start prophylactic and control measures the integration of syndromic surveillance into the existing public health system is one of the most important and difficult tasks at MGs. A more sensitive surveillance system would be able to distinguish signals of interest (i.e. smaller number of excessive cases) from “background noise”. While planning the implementation of syndromic surveillance, concerns whether systems of medical care and public health would be able to use obtained data for necessary action, are of paramount importance, since the final value of any epidemiological information depends on its practical application (62–64).

Complete evaluation of enhanced surveillance at MGs comprises many measures that are rarely mentioned in literature and even less applied in the fields. The most difficult is probably accountability of performance measurement (cost/benefit, efficiency and effectiveness). They should be measured against health outcomes which may occur or not. However, basic cost of the surveillance activities has to be assessed despite the problems with estimating benefits (59, 65, 66).

In ex post assessment other features of the quality of the system and of its performance (e.g. usefulness, flexibility, ease of use, reliability, data presentation and information shar-
ing) should be also taken into consideration, even if no ordinal numbers could be evaluated (7).

2.1.3.7 Training for surveillance at mass gatherings

In order to secure effective performance, increased acceptance and quality of leadership properly organized training is necessary for capacity building purposes for enhanced surveillance at local and national level. Training should be adjusted to the planned surveillance system at all levels. Sophisticated computerized analysis systems require in-depth training on basic system functionalities, statistical methods and data interpretation, visualization and presentation. The last step of this training should help public health officials in interpreting the data. They should also receive feedback regarding data clarity and practical usefulness.

Effective system of training should cover personnel at different stages of competence and professionalism including epidemiologists, other health professionals and lay people who will participate in collecting epidemiological data. Inclusion of people on different levels of competence requires separate courses, but for the purpose of effective coordination of surveillance activities, part of the training, especially practical exercises, should include all participants regardless of their level of competence. Besides, technical skills training should include promotion of acceptance, motivation and psychological preparation to unexpected adverse outcomes. It would be also advisable to include elements of leadership training for future local leaders in the system.

One of important issues in preparation of training scheme is proper timing. Early training, long before planned events, would be effective to motivate health professionals. Non-professional participants would be better motivated in the atmosphere of oncoming events. This should not be done in the “last minute” when they are busy with their other urgent obligations (67, 68).

Basic information not focusing on particular MGs can be obtained in numerous self-learning courses in the internet. Commercial E-learning courses cover elements of syndromic surveillance for interested people. There are also special courses, run at many schools of public health, focusing on public health problems and syndromic surveillance. In Europe those courses are less available than in North America, SE Asia and Australia.

Attached documents:
- Literature matrix on variables describing the epidemiological surveillance systems
- Basic bibliography on public health measures at mass gatherings

Published commented reviews of literature:
- Zielinski A, Gladysz K. Structured sanitary preparation to mass gatherings.
2.2 Structured checklist review (see attachment)

2.2.1 Introduction and method

The structured review of checklists was based on internet search engines (PubMed, Cochrane Library, Google), critical assessment of obtained results and also on review of publications quoted by other papers on the subject. Use of checklists for assessment of preparation to mass gatherings is quite widely used for two major purposes. First administrative authorities assess whether organizers fulfil all the legal or administrative requirements which are necessary to obtain the permit for organization of the events. Secondly, other types of checklists are targeted at internal evaluation of preparation to MGs. In most cases they are prepared by public health institutions. They point to risk factors of health hazards at mass gatherings and also to elements of infrastructure or control systems which can help to prevent, to reduce or to eliminate those hazards. In some cases requirements of administrative authorities concentrate on legal requirements, security issues and prevention of aggressive behaviour of participants. However, there are cases, in which checklists issued by authorities contain large parts of public health issues covering health risks and protective measures against them.

2.2.2 Results

Out of 39 checklists analyzed 26 contained administrative requirements which have to be filled in to obtain permission to organize an event; 26 were aimed at internal verification of preparation to mass gatherings. All, except one contained a basic outline of the meeting to allow them to be classified according to WHO criteria. Only four checklists required the reporting of the planned surveillance system. In two cases it was routine surveillance, the other two reported enhanced one. Enhancement of routine surveillance consisted of improved timeliness or broadened spectrum of reported infections. In three cases checklists inspected preparation of outbreak detection and only two of outbreak investigation. Syndromic reporting was included in three analyzed checklists, enhanced laboratory confirmation also in three. Questions regarding reporting of infectious diseases were included in seven checklists; requirements of pre-event risk assessment were included in 14. Regarding risk assessment three checklists had questions on incidence or prevalence of infectious diseases in host countries; one had questions on vaccination status of the host population. In two checklists questions on prioritization of infectious diseases were included. Sanitary and hygienic preparation was addressed much more extensively than epidemiological one. Questions regarding food safety were present in 21 checklists, water supply in 17 and refuse disposal in 14. Hygiene was included in eleven; sanitation control in eleven as well. Five had questions regarding rodent control.

25 of the checklists included enquiry about medical services: at the venue (16), in the municipality (5) or hospital based (8). Not even one checklist referred to health promotion at the event. Most checklists are devoted to safety issues like Emergency management plan (23), spectator management and crowd control (11). Most of the checklists stress communication and exchange of information. It was listed as “communication system” (20), “information centre” (27), “communication channels” (12) and – regarding medical information – data flow (13).
2.2.3 Discussion

Checklists concerning MGs deal most times not with surveillance or epidemiology at all. Structured sanitary preparation to mass gatherings is based on a set of instructions and legal requirements which are different for different jurisdictions. In many countries special checklists are used for itemized scrutiny of the sanitary preparation to the event. Those checklists are present in two forms. One is a relatively short list of legal requirements necessary for obtaining permission to organize mass gathering event. The other is a much larger set of questions which contains itemized comprehensive review of activities advisable for effective organization of the event. It includes safety measures as well as logistic structure of effective organization.

Some legal bills on MGs deal extensively with security measures. However sanitary supervision is left to “Sanitary Inspection” without any specifications to be checked and without clearly stated norms for sanitary infrastructure at the venues. There is a need for uniform instructions and checklists for use in scrutiny of sanitary preparation to MGs by State Sanitary Inspectors.

Mass gatherings bring to certain locations large numbers of people, who require additional services securing food, lodging, sanitary and medical care needs beyond usual level expected for permanent dwellers of the area. Close proximity of the participants at the events creates increased risk of infectious diseases, notably air and food borne, but also sexually transmitted ones and occasionally also related to substance abuse. Nowadays the possibility of intentional use of infectious agents at MGs has to be always taken into account, although no such incident was reported so far at major sporting events.

Preparation of the mass gathering event needs coordination of different services by the organizers. It also requires continuous supervision of pre-event, event-based and post-event activities for the safety and security of the participants and local dwellers.

Potential organizers should be well aware of the legal requirements regarding structured preparations to the event, which have to include necessary permissions from municipal authorities. Those legal requirements form the initial necessary set of conditions. It is strongly advisable that those elementary requirements functioning as a basic framework should be supplemented by additional, more detailed elements. These elements would adjust general rules to particular conditions of the event like: social type of the participants, local infrastructure, climate, weather and also the political atmosphere surrounding the event.

The responsibility for the safety of the event participants is largely the task of administrative authorities. They supervise local security services, fire fighters, and also sanitary-epidemiological personnel. Their responsibility comprises of the direct supervision of preparation, performance and cleanup. The collection of data, analysis and reporting as well as the implementation of control measures are within the responsibilities of both organizers and local sanitary and epidemiological services. The latter on should always be leading the event. During events organized by municipal administration natural systems of supervision hierarchy do not apply. The whole system of organization, its logistic and structure of specific supervision frames as well as control measures should be included in the large comprehensive scheme.

Checklists, which itemize the preparation to the event, can be divided into two types: short ones aimed on basic requirements for obtaining official permission by organizers, and larger, comprehensive ones which provide insight into detailed elements of the preparation. Detailed review of laws regulating organization of mass gatherings in different countries is beyond the scope of this analysis. In different countries legal base for the supervision is in-
roduced at different levels of judicial system. Problems related to MGs are frequently included in more than one bill.
Numerous application forms from different states and countries differ in details, but almost always cover the following elementary points:

- Identification of organizer and contact data to responsible person
- Specificity of the event (sporting, entertainment, religious etc.)
- Expected number of participants
- Location (usually with a map)
- Duration of the event

In some cases application forms contain additional questions, which otherwise are left for approvals granted by specific agencies. Those questions concern use of alcohol, fireworks, or expected noise level.
The number of specific plans required to be included in application package depends on the organization of administrative bodies, which cover different sections of the safety spectrum at MGs. Those specific plans invariably include:

- Fire protection approval
- Health and medical plans
- Public safety plans which cover crowd control and security services
- Parking and traffic control plan
- Lodging of participants, camping sites (if applicable)
- Sanitary plan
  - Type, number and location of toilets and washing facilities
  - Water supply
  - Food preparation and food service facilities
  - Solid waste collection and disposal system
- Insurance certificate

It is up to administrative authorities to evaluate sufficiency of submitted plans according to the local law. In most cases problems remain with precision of legal regulations and subjectivity of their interpretation.
Administrative supervision of the organization and the course of the event have two aspects. One is testing compliance of organizers to legal requirements and their own commitments, the other is surveillance of health events which may or may not depend on the organization of the event. Harmonious cooperation between organizers and administrative supervisors may help with setting up a framework for enhanced surveillance at the event, but certainly there are limits of the responsibility of the organizers for preparation and operating of the surveillance system. Legal requirements form a basic set of necessary conditions focused on rights of the administration and obligations of the organizer. A much wider and more detailed set of guidelines is advisable to minimize the probability of harm to participants at mass gathering event.
Out of many documents of this type, two require special attention. One is “Communicable disease alert and response for mass gatherings” prepared by experts of World Health Organization (12). This publication covers planning of the surveillance system, its implementation and operation with special reference to alert and response and to international exchange of information according to International Health Regulations. It is primarily designed for the use of governments as a sort of base for state legislation. It also provides model structure for organization of health care. Three major fields with further subdivisions are indicated:

- Population health
  - Surveillance
  - Food, water & sanitation
  - Disease control
  - Health promotion
  - Training
  - Laboratories
  - Environmental health

- Health services
  - Emergency medical services
  - Pre-hospital care
  - Spectator care
  - Trauma centres
  - Field teams
  - Drug testing
  - First aid

- Disaster planning and response
  - Training
  - Exercise
  - Surge capacity
  - Command and control of the public health and medical responses

Within proposed by WHO classification of mass gatherings fundamental distinction is between planned and spontaneous or more accurately those for which application was submitted in proper time and those which occurred unexpectedly for administrative authorities. Improvised gatherings put strain on all municipal services and may take an unexpected course. It may create unexpected risks, cause nervousness among participants and also among security forces.

Another manual “Safe and Healthy Mass Gatherings” is part of Australian Emergency Manual Series (13). It covers a wide spectrum of problems related to planning and operating of the mass gathering events. Concise structure and itemization of the elements of event prepara-
tion may prevent to overlook some issues, which are of importance or may become impor-
tant if adverse situation occurs. The document is divided into eight chapters:

- Pre-event planning
- Safety issues
- Additional [safety] considerations
- Spectator management and crowd control
- Public health
- Medical care
- The psychological dimension
- Special planning for high risk events

In addition the document includes 17 annexes: additional information of definitions (crowd
types, crowd catalysts, critical crowd densities, stages of behaviour, manual to the provision
of first aid) and checklists focusing on specific elements of the event preparation:

- Planning checklist for safe and healthy mass gatherings.
- Promoter checklist
- Authorizing body checklist
- Food vendor information sheet
- A checklist for food vendors

The rationale of this approach is obvious. Different bodies have different areas of responsi-
bility and any attempt of preparation of universal “risk assessment checklist” would produce
irrationally long questionnaires. People filling it would have to leave large parts untouched.
The most comprehensive one of above listed is “Planning checklist for safe and healthy mass
gatherings”, which still leaves many particular out of its scope. Promoter checklists and au-
thorizing body checklists are overlapping substantially: a promoter has to overview safety
measures to be prepared for scrutiny of authorizing body. However, organizational logistics
of the event are in general crucial for the promoter, but for authorizing body only its final
result is of importance (e.g. properly placed and trained personnel).
The Australian set of documents regarding “safe and healthy mass gatherings” names health
issues in several places. Chapter 5 “Public Health” lists risk factors and recommendations for
monitoring health risks (e.g. detailed hygienic requirements on personal hygiene, food and
water safety like food sources, transportation, storage, food handling staff consideration). It
also includes Australian norms for the number of toilets, water taps for hand washing and
drinking water sources in relation to the number of participants. The Australian document
describes requirements for medical care at the venue and out of venue including hospital
base. It has to be stressed, that equally important as preparation to the event and perfor-
amance during the event is sanitary cleaning after the event. It has to be itemized and signed by
responsible organizers as their legal obligation under control of “Sanitary Inspection”.

Attached documents:
- Matrix checklist
2.3 Personal information on expert experience regarding surveillance system at mass gatherings

We collected personal information and opinions from experts, who personally participated in epidemiological surveillance at large sporting events. We sent a list with open questions to them by mail prior to the interview. We recorded their opinions in telephone conversation. Interviews were focused on personal recommendations of best practices, and on exchange of information regarding unsatisfactory experiences. Twelve responses were obtained; four of those were obtained through telephone interviews and eight through a questionnaire.

Questions and analysis of responses:

1. Please identify mass gatherings, especially sporting events, at which you participated with a team of people organizing and/or performing epidemiological surveillance.

All the responses came from people having personal experience regarding surveillance system at mass gatherings. Some participated in large international sporting events:

1. Summer Olympics, Sydney 2000
2. Sydney Paralympic Games 2000
3. Winter Olympics, Salt Lake City 2002
4. Rugby World Cup 2003
5. Summer Olympics, Athens 2004
6. Euro 2004
7. Winter Olympics, Torino 2006
8. Football World Cup, Germany 2006
9. Cricket World Cup held in the Caribbean in 2007
10. EURO 2008
11. South East Asia Games 2009
12. Universiade (International University Olympic Games) 2009
13. Sydney world Masters Games 2010

There were other numerous events of different character in which respondents of the questionnaire participated as organizers or supervisors of public health activities including planning and operating surveillance systems used at those events. Apart from first hand
experience in surveillance at mass gatherings they had solid background and vast experience in epidemiology of infectious diseases including outbreak investigations. Detailed data on background of responders and information on their activities at mass gatherings are included in the responses.

2. Please describe your range of activity at mass gathering events.

Most of the respondents had quite extensive range of activity on data collection, processing and distribution of results, but also they trained personnel assigned to epidemiological services at mass gatherings, they provided consultations and performed outbreaks investigations.
Participation in pre-event planning of the surveillance system or modification of existing one was mentioned in most of the responses.
Some responses referenced training activities and providing advice for actions taken by other participants.

3. How would you describe the system of epidemiological surveillance in the events you participated in?

- Routine surveillance with enhancement of:
  1. new data sources
Use of new data sources was frequently included in the answers. New data sources were defined by place or facility reporting (temporary medical structures at the event venues, hotels, cruise ships, emergency departments, sentinel hospitals, sentinel general practitioners) and surrogate indicators like drug sales.
Also flagging of cases related to the mass gathering event was recommended, as well as daily review of international data sources on epidemiological situation with special reference to outbreaks.
There were also simple confirmatory responses “yes” without specification.
  2. timeliness
Improved timeliness was invariably reported in the answers, sometimes with pointing to the method used: e.g. change from weekly to daily reporting. None of the responders did mention change of the media of reporting or the external system of evaluation of the timelines.
3. extended laboratory confirmations

Extended laboratory confirmations were reported in most of the responses usually without specification of the method leading to it. One of the responders in other section of the questionnaire mentioned “finger-printing of bacteria”.

In most cases laboratory confirmations were done by existing set of laboratories usually existing in hospitals with help and supervision of reference laboratories.

4. other (specify)

As other system of enhanced surveillance was mentioned use of dashboard for syndromic surveillance. Some responses recommended the immediate reporting of measles; at the time of the event there were outbreaks of measles in the country independent from mass gatherings.

As other ways of enhancement of routine surveillance system integration of information from different sources and methodology of setting threshold for alarm were mentioned. In others exchange of information on daily conferences of participants involved in public health activities with other services was interpreted as enhancement of surveillance system.

- New system of surveillance especially prepared for the event.

In most cases there was no use of special new systems of surveillance introduced for mass gatherings in which respondents participated. As a rule the system was based on existing surveillance system with some more or less limited improvements.

In three occasions syndromic surveillance in sentinel posts was introduced as a new system prepared for the event.

4. Did you consider in your work results from pre-event risk assessment?

All answers pointed risk assessment as a tool to be used for prevention. All outcomes to be monitored were previously defined upon risk assessment taking endemic diseases, risk of disease importation, recent outbreaks in visitors’ countries, media attention (bioterrorism) etc. into account.

None of the answers referred to the details of methods used for risk assessment at mass gatherings.

Find below the list of the sources of information for risk assessment which was included in one response:
1. type of event (duration and geographical spread);
2. projected crowd densities;
3. characteristics of participants (including home countries);
4. local and international seasonal patterns of communicable disease;
5. global outbreak alerts
6. prevalence of temporary food vending/HACCP;
7. existing environmental hazards;
8. transient environmental hazards, particularly portable or temporary toilet and hand wash facilities;
9. access to medical facilities; and
10. known existing security alerts.

5. What infectious diseases have been detected by the system (set of priorities)?

The following diseases were listed by respondents as priorities for surveillance at mass gatherings in Europe: food-borne infections, measles, legionella, and influenza. A response from Laos was more elaborate. Apart from influenza and other acute respiratory infections it included dengue, typhoid fever, watery and bloody diarrhoea.

6. What has not been detected which has been detected later?

None of the responders gave positive answer to this question.

7. Challenges: describe obstacles, problems, mishaps if any.

Problems and challenges reported by respondents may be grouped in the following categories:

- problems with administrative authorities (lack of understanding of the importance of surveillance)
- problems with understanding of some improvements in surveillance system or with introduction of new system by other participating health professionals
- logistic and communication problems with implementation of surveillance system and harmonization of data from different sources.
- problems with technical base (insufficient computerization)
- overwork of personnel
• substantive issues (problem of setting background level of infections and with setting alarm threshold)
8. Lessons learnt:

If you would organise epidemiological surveillance for the similar event what would you change in comparison with the system implemented in the past events?

Suggested improvements for future mass gatherings may be categorized in similar way as challenges with focus on overcoming them. Most of the respondents suggest early start of preparation to the events to find consensus and secure cooperation among the key players in advance. Also technical improvements are suggested with special focus on computerized reporting and communication of data and the results or epidemiological analysis.

Important lessons come from difficulties of reliable predictions so flexibility of the surveillance system could be easily adjustable to the actual situation. On the other hand risk assessment is crucial for initial setting of the surveillance system, which as one of the respondents points out, should be adjusted to the size and character of the event and not always require enhancement from routine one.

9. Could you list some elements which you deem crucial for effective surveillance at mass events?

Answer of one respondent:

- All planning for mass gatherings should consider the opportunity for leaving a legacy for future public health systems in the host country. This occurred in NSW, Australia.
- Not all mass gatherings require the same level of investment in surveillance and depend on the outcomes of the risk assessment.
- Firstly, it is preferable to use enhanced existing systems, i.e., with routine syndromic surveillance already occurring in NSW it makes the monitoring of smaller events easier, with minimal costs and enhancements. Near real-time data from this system is made available to response teams 2 to 3 times daily, if needed, and can be provided to event organisers, other Agencies, media, politicians and the community.
- Any systems need to be;
  - planned well in advance (2-4 years out);
include the service providers affected, e.g. Emergency Department staff, organising committees;

- comprehensive in coverage or use clear logic for the use of particular sentinel sites;
- resourced and staffed, e.g. access to central support teams should be available to provide timely advice to users;
- provide data need that are timely and use automated reporting, where possible;
- data, in particular syndromic data, should be reviewed by experts prior to reporting;
- be considered for the long term, i.e. does it meet a critical infrastructure need for public health surveillance on an ongoing basis or can it be ‘shelved’ to be re-used for future events

Other respondents also stress that whenever possible the existing system should be used, which is easier to be operated by personnel accustomed to it and experienced in its operation. It is also important that extra effort put in the enhancement surveillance system and experience gained at mass gatherings should be used for future improvement of the existing system.

Another issue which was stressed by respondents is the need for good communication within the system, between people operating the system and recipients of the obtained information and warnings. Both collective bodies set for exchange of information as well as communication channels should be planned in advance.

Some other important advices concerned preparation of technical base and surge capacity to perform the task related to public health operations at mass gatherings.

10. Regarding training to prepare personnel for epidemiological services at mass gatherings, what subjects and materials should be included in such training?

Responses concentrated on suggested subjects which should be included in the training and also on structural and logistic principles. It was suggested to train the trainers to be able to cover wide range of personnel for public health operations at mass gatherings.

The major suggested subjects of training were:

- specificity of public health and epidemiological problems at mass gatherings
- new elements of surveillance system which may be new to the personnel accustomed to previous routines
- risk assessment and hazard identification
- technical tools which may be new to the personnel
- harmonization of data coming in different formats from different sources
- event specificity and adjustment of the surveillance system to the character of mass gathering.

Special consideration was devoted to outbreak investigations, statistical tools and using past experience from other countries. As training media e-learning, posters, and regular classes were suggested. Some respondents strongly recommended simulation exercises.

There is general consent that training should start as early as technically possible – about 1-2 years before the event.

11. What is your opinion on the usefulness of special checklists which put some order into supervision on preparation on mass gatherings? Do you have any suggestions how those checklist should be structured?

There was a general agreement about the usefulness of checklists. Some respondents pointed to the need of tailoring checklist to the specificity of the event. It was also mentioned that literature contains large numbers of ready-to-use checklists but they should be adjusted to local conditions and focused on particular sections of public health preparation. In one response it was indicated that proposed checklists should be accompanied by comment with key guiding principles and that its use should be adjusted by personal experience and recognition of local conditions including infrastructure.

12. Do you have any advices regarding assessment of the population forming denominator in calculation of incidence at mass gatherings.

Most of the respondents expressed scepticism regarding attempts to calculate denominators since there is no real control of people movements and no reliable tool for estimation the number of visitors. So any estimation would be prone to errors. There were advises to concentrate on the number of cases, with special focus on outbreaks and on mapping of their occurrence. Also flagging of cases related to the event was advised
In one response the electronic control of movement of visitors was suggested, in another one to base incidence on the number of permanent inhabitants.

2.4 Previously prepared comprehensive documents on risk assessment and epidemiological surveillance at mass gatherings:

a. WHO documents:

b. EpiConcept documents
   i. Strengthening surveillance and response to communicable disease and possible deliberate release threats ahead of mass gatherings, a toolkit for EU Member States ECDC tender OJ/2008/02/29 - PROC/2008/004

c. Australian government
3 Surveillance - core capacities: planning tools

3.1 Introduction

In Europe international mass gathering events taking place differ largely, e.g. with regard to the demographics of the attendees, the venues, and the context in which they take place. Therefore the development of a guidance method for public health professionals fitting all the different types of mass gatherings is a challenging task.

This tool should guide health professionals to identify and prioritize health threats relevant for the mass gathering, to identify the level of resource including a gap analysis of surveillance systems, and to decide on additional/extraordinary surveillance activities to be implemented. For specific diseases different options for the surveillance activities are given (optimal surveillance approach, 2\textsuperscript{nd} and 3\textsuperscript{rd} option). Based on the available resources and the risk assessment, an informed decision on priorities with regard to the disease under surveillance and the scope of the surveillance can be taken.

The key issue is that capacities and performance of the surveillance system will be tested against real epidemiological situation in real local and external circumstances. Those circumstances consist of:

- Size, duration and character of mass gathering
- Existing infrastructure at the venue, in local administrative district, and for some mass gatherings also in the state
- Material base and organisation of medical services at the venue and in the area of the event
- Risks of different kinds of adverse health events
  - related to the character of the mass gathering
  - epidemiological conditions in local surroundings, and in the visited country, but also in countries of visitors
  - dependent on factors related to behaviour
  - related to deliberate release of biological agents, toxins or physical factors
  - related to local climatic or meteorological conditions
  - basic health and immune status of participants – vulnerability of the population taken into account (both local and visiting)
  - structural and operational capacity to alleviate adverse effects related to risk factors

The content of core surveillance capacity should be adjusted to the specific circumstances of planned or expected mass gatherings which can considerably differ depending on the specific situation. Too elaborated surveillance system may generate unjustified excessive ex-
penses and personnel efforts. On the other hand insufficient surveillance may lead to inadequate detection of cases or outbreaks resulting in insufficient control measures. Even the best system of risk assessment may fail to predict the real incidence of diseases related to the MGs or occurring independently of them. Therefore flexibility of the system is need with capacity of further enhancement in the case of unexpected developments.

The toolbox/checklist should enable decision makers to identify what aspects and variables they have to take into consideration when planning a mass gathering. The development of a basic framework includes proper identification and definition of the major problems at mass gatherings (with focus on infectious diseases). It is aimed to integrate the toolbox/checklist to local risks and needs as well as existing resources (71). Rational preparation of surveillance system for mass gatherings should be based on specificity and the size of gathering, conditions at the venue, existing infrastructure, and available resources and reserves.

Here we present tools which can be used for the assessment
- Characteristic of the referred mass gathering
- Review of infrastructure at the venue and in surrounding area
- Resources overview including existing surveillance system
- Risk assessment of events being subject of surveillance
- Assessment of needs
- Design of enhanced surveillance
- Evaluation of performance

For each item listed above sources of information may be different. Also tasks can be performed by different staff or at different times. This is why a long comprehensive checklist rarely suits all the items equally well, and even more rarely is operationally swift. Thus, we recommend preparing shorter, but more detailed and accurate checklists for each of the bullet points listed above or for closely related groups of problems.

From the standpoint of economics it should be accepted as a general principle that the checklist should only include those items that are relevant from the perspective of the expected tasks. Inert elements from the viewpoint of the planned activity should not be reviewed.

Effective manner of developing or modifying surveillance system with focus at mass gatherings requires a number of steps to reach the final goal. An attached algorithm was proposed to organize the steps in this direction.

A list of those diseases should be assembled on the basis of background information concluded from previous experience at mass gatherings as well from characteristics of those diseases, namely severity and infectiousness in the conditions of mass gathering event. The information on this subject is derived from literature review and from expert opinions.

Other background information is obtained from analysis of surveillance standards for infectious diseases. This is based on direct observation of functioning surveillance systems and from literature review. Comments of experts played an important role, both in evaluation of quality of different surveillance systems and in assessment of their adaptability to conditions of MGs.

Based on background information a series of steps were identified for the planning of sur-
veillance of infectious diseases for which appropriate tools are presented:
  - Assessment of mass gathering –
    - Tool: Checklist (annex 1 and 8)
  - Prioritization of infectious diseases of concern
    - Tools:
      - List of agents/diseases (annex 2-1, 2-2 and 2-3)
      - Description of options for surveillance of different categories of infectious diseases (annex 3)
      - Risk assessment matrix (annex 4)
  - Setting a threshold for including risks.
  - Assessment of attributes of surveillance system relevant for mass gathering – checklist of criteria
    - Tool: Checklist (annex 5)
  - Analysis of gaps and insufficiencies of existing surveillance system – itemized comparison of benchmarks for model surveillance system and the corresponding parameters of the existing system.
  - Assessment of needed resources
    - Tool: Checklist (annex 6)
  - Decision on the design of new surveillance system or on amendments of existing one, based on:
    - Analysis of gaps
    - Resources and surge capacity
    - Assessment of political will of decision makers

The document below follows those steps with analysis of the evidence for their rationale and providing tools for their implementation.

### 3.2 Assessment of the characteristics of mass gathering - review of infrastructure at the venue and in surrounding area

A checklist prepared for this purpose has to cover basic information regarding planned mass gathering: its purpose, expected type and number of visitors, and planned duration of the event. Information on the infrastructure will enable planning of important elements of material foundation on which the surveillance system can be based. Appraisal of the facilities and infrastructure at the venue and in the surrounding area can serve as an accessory tool for risk assessment.
An overview on technical elements of the venue and its infrastructure should concentrate on relevant ones, like sanitary utility, and may facilitate or hinder epidemiological surveillance. Others, no matter how important, are the domain of other services. A checklist is not only a tool of assessment but it can also be used as a basis for occasional intervention. In annex 1 an example of a checklist for the assessment of a mass gathering event is presented. Furthermore, sources of checklists proposed by EPI Concept, Emergency Management Australia and Northwest Centre for Public Health Practice at the University of Washington are given in the literature section.
3.3 Prioritization of infectious diseases of concern during a mass gathering event

3.3.1 Food-borne diseases

Food-borne infections are the most frequently reported infectious diseases during mass gathering events. Interest for those diseases emerges from the fact that mass gatherings provide special opportunity for food vendors, restaurants and catering services to do business - the number of those places poses a particular challenge for food safety inspection. Even more challenging are those gatherings which are associated with camping and food preparation by the participants.

There are numerous examples of outbreaks of food-borne diseases directly associated with MGs or occurring at the same time in the area of the event. Most of the cases occur among visitors, but some were also reported among staff and athletes. In 1980 Olympic Games a Finnish marathon runner dropped out of race because of a diarrheal episode. Concerns of diarrheal diseases were especially serious at Mexico Olympic Games due to the city’s reputation of frequent gastrointestinal infections. In a study of the efficacy of antimicrobial drugs in the prevention of travellers’ diarrhoea Kean and colleagues found attack rates of moderate or severe diarrhoea among young visitors from the USA at 17% (72).

In numerous reports of diarrheal diseases most frequently Salmonellosis was reported. During the Olympic Games in Beijing Salmonella enteritidis was found in 57.8% of confirmed cases of diarrheal diseases. Vibrio parahaemolyticus, Salmonella, diarrhoeagenic Escherichia coli and Campylobacter jejuni were found to be the primary bacterial pathogens during the Olympic Games.

In the reports on surveillance from 2004 Olympic Games in Athens 52% of 416 reported cases were Salmonellosis, although only 1.2% were attributed to Olympic Games. Though, criteria of this attribution were not completely clear (73).

Other etiologic factors were reported less frequently at MGs. An exception is Norovirus infection, which occur frequently in outbreaks covering large numbers of people in different types of gatherings. These outbreaks occur quite frequently on cruise ships including those used as hotels for visitors of large sporting events. E.g. a Norovirus outbreak was diagnosed at an international scout jamboree in the Netherlands, July-August 2004 (3). Also in Germany outbreak of gastroenteritis occurred at the time of 2006 World Cup. Out of 69 cases, 62 were Norovirus infections (61 with an epidemiological link to a Norovirus outbreak in Munich), four salmonella infections cases and three were cases of campylobacter infections. (32).

3.3.2 Upper respiratory diseases

Another group of diseases that may pose a threat at mass gatherings are upper respiratory infections including influenza, which - especially during the pandemic (H1N1) 2009 - may be a serious public health problem both for visitors and for organizers.

3.3.3 Vaccine preventable diseases

Vaccine preventable diseases like measles, mumps and meningococcal disease should be considered separately taking the epidemiological situation in visited and visitors’ countries, vaccine coverage of visited and visitors’ population, and the prevalent age of gathered peo-
ple into account. There were reports of measles outbreaks in countries hosting large sporting games and serious outbreaks of meningococcal diseases related to Hajj Pilgrimage (74, 75).

3.3.4 Other infectious diseases of concern including diseases due to intentionally released pathogens

Other diseases may be of local importance depending on the local infrastructure, environment in the hosting country, susceptibility and vulnerability of the population attending the gathering, and in some cases also on animal health. Some infections of importance do not qualify to be included in surveillance at mass gatherings because of long incubation period like STI and blood borne infections in particular HIV and hepatitis C. Those diseases may spread at some types of mass gatherings, but rarely may be diagnosed at the period of their duration. Rather they should be a subject to appropriate health promotion activity and of preventive measures. Bioterrorism is an issue universally present at all large mass gathering events in the last decade, especially after Sept 11th 2001. Probability of such an attack is difficult to estimate, but existence of such a threat cannot be denied. Moreover, the impact of bioterrorist attack with group A of CDC list of infectious agents with bioterrorist potential (see annex 2) could be disastrous. This is why every system of surveillance at mass gatherings should include signals for single confirmed case of presence of material or infection involving any of those agents. But implementation of elaborated syndromic systems of surveillance, like those used at mass gatherings in the USA, could vastly increase cost as well as implementation and also operational efforts by epidemiological services. This would only be justified if meticulous risk analysis indicates their need.

3.3.5 List of the major infectious diseases

The list of 16 health conditions below provides set of infectious diseases suggested by experts as a starting point for setting of diagnostic and reporting standards as well as implementation of risk assessment procedures.

**Gastrointestinal diseases**

- Salmonellosis
- E. coli-infection
- Campylobacter infection
- Shigellosis
- Staphylococcal food poisoning
- Hepatitis A
- Norovirus infection
- Gastrointestinal infection – unspecified

**Respiratory diseases**

- Influenza
- Avian influenza
- Legionellosis

**Vaccine preventable diseases**
- Measles
- Meningococcal disease

**Locally endemic infectious diseases**
- Q fever
- Leptospirosis

**Intentionally release pathogens/toxins**
- Anthrax
3.4. Options for the surveillance of infectious diseases of concern

3.4.1 Descriptions of surveillance approaches/tools used in mass gathering events

Surveillance systems at mass gatherings developed steadily as the epidemiological knowledge and experience accumulated. The following approaches have been used in mass gathering events:

**Routine surveillance**

Assessment of the surveillance system used for mass gatherings cannot be based solely on the list of improvements added to the existing system. The routine background may be crucial as a starting point of surveillance activities. Inadequate performance of routine surveillance puts extra burden on organizers of the surveillance system. It increases both the setup effort and operational one when the system heavily amended has to be put in practice. A more reliable way to analyze levels of surveillance activities can be carried out by successive examination of the individual characteristics of the system in terms of quality of supervision. Evaluation of the existing basic system of surveillance, which is in operation within the area of the mass gathering, should start from two basic points:

- List of reported diseases
- Fraction of laboratory confirmed cases among reported ones.

Review of the attributes of the surveillance system should follow that basic ascertainment. Sniegoski and colleagues provide information in their presentation (7) on the elements which were used to enhance surveillance systems since Summer Olympics in Los Angeles in 1984 till World cup in Germany in 2006.

**Enhanced routine surveillance**

In most cases surveillance at mass gatherings was based on previously existing systems with the improvements of sensitivity (sensitisation of physicians, laboratories etc.) timeliness by increase of reporting frequency and acceleration of data transmission, then by use of additional data sources and enhancement of communication on national and international levels by increase the number of recipients and/or increase of the fraction of laboratory confirmations.

Some countries like Germany and Austria use systems (32) which are based on existing laboratory reporting with an enhancement that consists of:

- Accelerated data transmission
- Event-based surveillance
- Introduction of an additional free-text reporting (apart from the pre-existing definition based)
- Monitoring of domestic and international media sources
- Strengthening of communication and interaction between different public stakeholders within the country and abroad.
Syndromic surveillance

Syndromic surveillance was rarely employed prior to Sept 11th, 2001. After this date, first in the USA and later in other countries syndromic surveillance was used with increasing frequency (7). The set of syndromes to be reported almost invariably resembles an abbreviated form of the list prepared in CDC for the purpose to detect bioterrorist attack (see annex 2). However, this does not mean that syndromic surveillance is universally accepted as a necessary tool at mass gatherings.

Event-based surveillance

Event-based surveillance is recommended as an addition to the basic systems of indicator-based surveillance in order to fill potential gaps and to detect cases or outbreaks which did not enter the basic surveillance net or were not detected in it. It relies on external sources of information regarding cases/clusters of diseases, unexplained deaths and also events related to potential sources of exposure like diseases and deaths of animals, breach of water of food safety, and other environmental hazards. Implementation of event-based surveillance requires not only preparation of communication channels with selected medical and community settings but also openness for obtaining information from unexpected sources. In most cases information obtained from event-based surveillance has a crude unstructured form. It has to be properly defined, verified and classified according to the requirements of prevention and control measures.

Examples for other data sources

- over-the-counter drug sales
- absenteeism (Beijing)

3.4.2 Disease-specific surveillance options

3.4.2.1 Food-borne diseases

A. Standard

Aim:

Rapid detection of cases with gastro-intestinal symptoms and rapid diagnosis of the pathogen in order to implement adequate measures to prevent spread of disease: assessment of fraction of hospitalized cases, structured clinical description of clinical symptoms, mortality rate, and duration of symptomatic condition of hospitalized cases for assessment of the severity of disease.

Prerequisites:

- syndromic surveillance in site clinics/hospitals established (sensitization of physicians)
- laboratory capacity to diagnose pathogens in a timely manner available and accessible (24 hours/7 days)
- reporting instruments and timely data transmission to responsible health authorities established (local, intermediate and national level)
- structured forms of clinical reporting of hospitalized cases
- analysis system of data from syndromic surveillance established
- definition of alert threshold for the syndromic surveillance established

Description
A standard laboratory should be able to diagnose stool and serum specimens for the most frequent food- and water-borne diseases listed above. In the case of negative results for any of those infectious agents reference laboratories should be available to widen spectrum of diagnosed agents (cryptosporidium, giardia).

Prompt outbreak detection is of special importance. Syndromic surveillance questionnaire should always include questions on other similar syndromes which occur within a short period of time from the interviewed case and may be linked by exposure. Algorithmic outbreak detection programmes are of special value in syndromic surveillance systems.

None of the surveillance systems operating at mass gatherings analyzed in literature review met all the criteria listed above as an optimal standard.

B. Enhanced laboratory-based and event-based surveillance

Aim:
Enhanced laboratory-based routine surveillance of pathogens causing gastrointestinal symptoms in combination with event-based surveillance

Prerequisites:
- Laboratory capacity to diagnose pathogens causing gastrointestinal pathogens in a timely manner available and accessible
- Reporting instruments and timely data transmission to public health authorities established (local, intermediate and national level)
- Definition of alert threshold of laboratory-confirmed cases established
- Event-based surveillance focussing on venue site(s) established
- Reporting instruments and systems to forward information to the public health authorities established (local, intermediate and national level)

Description:
A typical example of enhanced laboratory and event-based surveillance is the system employed in Germany at the World Cup 2006 (30-32). It included:
- Accelerated case-definition based mandatory notification: daily replaces weekly transmission
- Flagging of World Cup-related cases
- Inclusion of foreigners
- Additional daily free-text reporting
- Daily assessment of international & national situation
- Expert press monitoring
  - European Early Warning and Response System (EWRS)
- Lay press monitoring
  - 25 local newspapers covering the World Cup cities

Enhancement included two additional points:
- Timeliness (from weekly to daily)
- Daily assessment

In Portugal at EURO 2004 the surveillance system was mainly based on hospital reporting, but the whole set of sources included also Public health Laboratories, Primary Health Centres and lay citizens. Routine surveillance system was also in place with enhancement to daily reporting (33).

For EURO 2008 held in Austria and in Switzerland the reporting system was based on reports from laboratories and on daily reporting of cases with special reference to early detection of food-borne outbreaks (34).

During Athens 2004 Olympic Games enhancement of surveillance system included daily reporting of laboratory results on stool cultures and on serology of 25 selected pathogens, and daily directly reporting from an extensive number of sentinel hospitals to the Hellenic Centre for Infectious Diseases Control. Zero reporting was included (76).

**C. Syndromic surveillance**

Syndromic surveillance for food-borne diseases at mass gatherings has strong promoters and strong opponents. On the promoter side are such arguments like high sensitivity of outbreak detection and good timeliness. The opponents focus on the problem of specificity and additional cost since most of syndromic surveillance systems are independently designed from the scratch based on routine surveillance in place.

Among major MGs at sporting events, a syndromic surveillance system for food-borne disease was in operation at Winter Olympic Games 2006 in Torino, at Summer Olympic Games 2000 in Sydney and at Summer Olympic Games 2004 in Athens. In all those cases syndromic surveillance operated along with basic surveillance system. In some cases like in Athens Olympic Games the list of reported syndromes was widened to match the CDC list of symptoms related to those which might occur at the most probable and dangerous bioterrorist attacks caused by infectious agents of the group A. All of the experts who reported application of surveillance system in direct interviews were satisfied with the results. Tsiodras Sotrios (Athens 2004) (literature matrix) underlined superior sensitivity of the syndromic surveillance which was able to detect food-borne outbreaks which were overlooked by labora-
tory- and case-based systems. Critics pointed out that syndromic surveillance may consume a large fraction of available resources.

**D. Laboratory-based surveillance**

Exclusively laboratory-based surveillance for food-borne disease put extraordinary requirements on the laboratory system and reporting. Therefore it is quite rarely implemented. Pre-requisites for effective laboratory-based system of surveillance include extended data sets accompanying specimen sent to laboratory and extraordinary timeliness of reporting.

The unquestionable need of enhanced laboratory capacity was stressed by all the experts for any type of surveillance system at mass gatherings. Enhanced laboratory capacity and increased fraction of laboratory confirmations were underlined in most epidemiological reports from surveillance data at major sporting events as well as from other types of mass gatherings. During the Summer Olympics 2004 in Athens this was achieved with a especially dedicated net of laboratories with selected reference ones and a list of infectious agents for which testing was obligatory. In some other reports in our literature review as well as in direct interviews of experts enhanced laboratory capacity seemed to be a simply increased fraction of confirmations. None of the reviewed surveillance systems relied exclusively on laboratory reporting. Elements of case-based reporting from clinics or hospitals were present in all of them.

### 3.4.2.2 Respiratory diseases

Mass gatherings, in particular those with dense crowds and with widely spread vocal expression of emotions like sporting events, have definitely an increased risk of upper respiratory infections. This risk is of special importance when infections are new to the exposed population like the new pandemic strain of influenza. Year 2009 brought new experience regarding mass gathering events at the time of the influenza pandemic (H1N1) 2009. The early epidemic in Mexico prompted organizers of football league matches to play with empty stands at the stadiums according the prepared schedule. 2009 WHO document “Interim planning consideration for mass gatherings in the context of pandemic (H1N1) 2009 influenza” (77) provides the following recommendations regarding detection and monitoring event-related pandemic influenza:

“Specific issues for event organizers to consider in consultation with public health authorities in the host country include:

- The role of diagnostic testing for pandemic (H1N1) 2009 influenza in view of available laboratory capacity (i.e. trained personnel and test kits) for real-time transcription polymerase chain reaction (RT-PCR) testing15 and the limitations of rapid influenza antigen tests.16 If ILI occurs among participants at the mass gathering it will be important to document the cause. However, it will not be practical nor necessary to laboratory confirm all cases of ILI and clinically-based diagnosis will need to be adopted.

- Mechanisms to enhance detection of event-related cases such as surveillance of persons who become ill and are treated at on-site medical clinics/facilities
or staff working at the event (e.g. health-care workers, security staff, and mobile response teams).

- The time period to undertake event-related surveillance in view of the duration of the event and the epidemiological characteristics of the pandemic virus.”

A. Standard:

Decision regarding inclusion of upper respiratory tract infections in surveillance system at mass gatherings should be based on risk assessment with strong consideration of actual epidemiological situation in the host country and in the visitor’s countries. Detection of cases with symptoms of upper respiratory tract infections and diagnosis of the causative pathogens should be done in recognition of the need to implement adequate preventive measures.

Algorithmic detection of outbreaks is of special importance at the time of the pre-pandemic and also pandemic phase. The following should be included: assessment of the fraction of hospitalized cases, structured description of clinical symptoms, mortality rate, and duration of symptomatic time period of hospitalized cases to assess the severity of disease.

Prerequisites:

- syndromic surveillance in site clinics/hospitals established
- laboratory capacity to diagnose pathogens in a timely manner available and accessible (24 hours/7 days). Reference laboratories with capacities for real time PCR is of special importance.
- reporting instruments and timely data transmission to responsible health authorities established (local, intermediate and national level)
- structured forms of clinical reporting of hospitalized cases
- analysis system of data from syndromic surveillance established
- definition of alert threshold for the syndromic surveillance established

Legionellosis

It is a disease with a known history of occurrence at MGs. It presents as consolidated pneumonia which only can differentiated from pneumococcal pneumonia by microbiological testing. Less severe presentation of Legionella infection without pneumonia, called Pontiac disease, is more or less solely diagnosed during outbreak investigations. Its infectiveness has an environmental character. The infectious agent Legionella sp. spreads with dispersed water from cooling towers, air conditioning or showers; the disease is not transmitted from human to human. Its incubation time of 2-18 days (mean 5-6 days) indicates that most of cases diagnosed at the time of the event were infected before in some other places.
Each case diagnosed at medical facilities should be investigated for previous use of hotels, spas, swimming pools, fountains and other facilities which may spread aerosolized water; proper microbiological analysis at those facilities should be performed. Pre-event investigation of hotels and other facilities which may spread aerosolized water should be under scrutiny before the event.

3.4.2.3 Vaccine preventable diseases

Vaccine preventable diseases form a group of special conditions. This group comprises almost invariably diseases of epidemiological importance due to high infectivity and/or clinical severity. Their impact depends not only on characteristics of the disease itself, but also on vaccine coverage. However, the coverage of the general population does not always prevent outbreaks if mobile groups with improper coverage are added.

Measles

Measles has quite high vaccine coverage in the general population of most European countries. Older age groups of people who were not vaccinated have a high prevalence of natural immunity. Still there are outbreaks of measles in numerous European countries due to import of the disease from other parts of the world and subsequent spread among susceptible subpopulations.

Standard:

The intensity of surveillance activities should depend on the risk assessment of the general epidemiological situation and estimates of vaccine coverage. Routine surveillance with confirmation of all suspected cases, according to WHO Measles elimination Programme, would be sufficient. The only exception is special situations when outbreaks in host or visitors’ countries are occurring. Therefore, enhanced surveillance should be implemented during outbreaks. Optimally measles should be initially diagnosed in syndromic surveillance by the syndrome “fever and rush”. Due to many different diseases that are covered by this syndrome prompt laboratory confirmation is mandatory to confirm the diagnosis. The incubation period of measles is up to two weeks, so cases found at the mass gathering event acquired the infection earlier, for instance in outbreak settings outside of the event area. However, they are a source of infection for the further spread in places distant from the event afterwards. Outbreaks of measles are reported by international networks accurately so that mandatory contact tracing is feasible for epidemiological services in the country of affected visitors/contacts. Persons with clinical signs and symptoms of measles should be instructed to consult public health services in their own country for proper diagnosis/confirmation in case that they leave the area of the event shortly after appearance of symptoms. Material for testing should be collected within 5-7 days after onset of symptoms.

Prerequisites:

- syndromic surveillance in site clinics/hospitals established
- laboratory capacity to diagnose pathogens in a timely manner available and accessible (24 hours/7 days). Reference laboratories with capacities for cul-
ture and real time PCR is of special importance for contact tracing.

- reporting instruments and timely data transmission to responsible health authorities established (local, intermediate and national level)
- structured forms of clinical reporting of hospitalized cases
- analysis system of data from syndromic surveillance established
- definition of alert threshold for the syndromic surveillance established

**Meningococcal disease**

Meningococcal disease causes life-threatening meningitis and sepsis conditions. In early stage of the disease it can appear as flu-like symptoms resembling upper respiratory tract infections. Among the other most frequent causes of bacterial meningitis (Haemophilus influenzae, Streptococcus pneumoniae, rarer Staphylococcus aureus, Enterobacteriaceae, Listeria monocytogenes) it is usually presented as primary disease, not as a complication of previous infection. Another feature is its high epidemic potential – its frequent occurrence in clusters.

**Standard**

It is rather unrealistic that meningococcal disease will be detected in syndromic surveillance under the heading of “meningitis” or “fever and rush”. It is a rapidly developing severe disease and is easily detected in medical facilities. The major problem is the immediately necessary hospitalization in reference hospital providing immediate diagnosis and treatment. First contact physicians should be instructed to provide instant antibiotic treatment prior to hospitalization especially in severe and rapidly worsening cases. Contact tracing is mandatory for confirmed cases of meningococcal diseases

Prerequisites:

- laboratory capacity to diagnose pathogens in a timely manner available and accessible (24 hours/7 days).
- reporting instruments and timely data transmission to responsible health authorities established (local, intermediate and national level)
- structured forms of clinical reporting of hospitalized cases
- analysis system of data from syndromic surveillance established
- single case should set alert threshold
- Diseases of local importance

### 3.4.2.4 Locally endemic infectious diseases

**Q fever**
Q fever is a highly infectious zoonotic disease caused by the coccobacillus Coxiella burnetii. Its clinical spectrum ranges from unspecified fever to atypical pneumonia, sometimes even progressing rapidly. It spreads by direct contact or by inhalation of contaminated particles in the air. The most frequent source of infection is infected livestock or domestic animals. Human-to-human transmission is rare.

The disease was noted very widely all over the world, but its incidence varies profoundly between different geographical regions. Risk assessment should facilitate the decision if Q fever is a surveillance priority at MGs. Incidence in host and visitors countries as well as pre-event contact with livestock of participants should be taken into consideration in this decision.

An incubation period of 2-4 weeks indicates that cases diagnosed at the event were infected prior to the event in the place they were residing at that time. Information about the cases should be reported to the responsible public health authority of the places where cases resided during the time of infection according to the incubation period.

**Prerequisites:**

- laboratory capacity to diagnose pathogens in a timely manner available and accessible (24 hours/7 days).
- reporting instruments and timely data transmission to responsible health authorities established (local, intermediate and national level)
- structured forms of clinical reporting of hospitalized cases
- analysis system of data established
- communication channels with epidemiological services of visitors countries established

**Leptospirosis**

Leptospirosis is a zoonotic disease caused by spirochete Leptospira sp. Infection occurs mostly by contact with urine or tissues of infected domestic animals or rodents cohabitating the area. The clinical presentation depends on the serovars causing the infection taking the variety of different signs and symptoms into account. Laboratory confirmation is necessary for proper diagnosis.

The probability of leptospiral infection at mass gatherings depends not only on the local endemicity of the diseases, but also on the activities at MGs which may facilitate contacts with infected animals. Inclusion of leptospirosis into surveillance system should follow rigorous risk assessment.

**Prerequisites:**

- laboratory capacity to diagnose pathogens in a timely manner available and accessible (24 hours/7 days).
- reporting instruments and timely data transmission to responsible health au-
3.4.2.5 Intentionally released pathogens/toxins

Agents of bioterroristic potential:

Even though the probability of occurrence of deliberate spread of infectious agents is hard to estimate organizers of surveillance system at mass gatherings should include those infections or intoxications in the high priority list of reported events. The literature covering surveillance at mass gatherings provides numerous examples of syndromic surveillance system, especially focusing on outbreak detection for diseases with bioterroristic potential. Such systems are usually expensive, high operational efforts are needed to implement and run these systems. Therefore, their implementation may only be recommended in rare cases when a very high risk of bioterrorist attack at particular gathering exists. More modest approaches would limit the surveillance to a syndromic assessment of cases presenting in medical facilities. The following table prepared by CDC shows syndromes related to infectious agents with bioterrorist potential:
## Syndrome Definitions for Diseases Associated with Critical Bioterrorism-associated Agents (CDC Category A)

<table>
<thead>
<tr>
<th>Syndrome</th>
<th>Definition</th>
<th>Category A Condition</th>
</tr>
</thead>
</table>
| Botulism-like             | ACUTE condition that may represent exposure to botulinum toxin  
  ACUTE paralytic conditions consistent with botulism: cranial nerve VI (lateral rectus) palsy, ptosis, dilated pupils, decreased gag reflex, media rectus palsy.  
  ACUTE descending motor paralysis (including muscles of respiration)  
  ACUTE symptoms consistent with botulism: diplopia, dry mouth, dysphagia, difficulty focusing to a near point. | Botulism             |
| Hemorrhagic Illness       | SPECIFIC diagnosis of any virus that causes viral hemorrhagic fever (VHF): yellow fever, dengue, Rift Valley fever, Crimean-Congo HF, Kyasanur Forest disease, Omsk HF, Hantaan, Junin, Machupo, Lassa, Marburg, Ebola  
  ACUTE condition with multiple organ involvement that may be consistent with exposure to any virus that causes VHF  
  ACUTE blood abnormalities consistent with VHF: leukopenia, neutropenia, thrombocytopenia, decreased clotting factors, albuminuria | VHF                  |
| Lymphadenitis             | ACUTE regional lymph node swelling and/or infection (painful bubo—particularly in groin, axilla or neck)                                                                                                     | Plague (Bubonic)     |
| Localized Cutaneous Lesion| SPECIFIC diagnosis of localized cutaneous lesion/ulcer consistent with cutaneous anthrax or tularemia  
  ACUTE localized edema and/or cutaneous lesion/vesicle, ulcer, eschar that may be consistent with cutaneous anthrax or tularemia  
  INCLUDES insect bites  
  EXCLUDES any lesion disseminated over the body or generalized rash  
  EXCLUDES diabetic ulcer and ulcer associated with peripheral vascular disease | Anthrax (cutaneous)  
  Tularemia             |
| Gastrointestinal | ACUTE infection of the upper and/or lower gastrointestinal (GI) tract  
SPECIFIC diagnosis of acute GI distress such as Salmonella gastroenteritis  
ACUTE non-specific symptoms of GI distress such as nausea, vomiting, or diarrhea  
EXCLUDES any chronic conditions such as inflammatory bowel syndrome | Anthrax (gastrointestinal) |
Prerequisites for effective diagnosis and management of diseases reported in syndromic surveillance system:

- laboratory capacity to diagnose pathogens or toxins in a timely manner available and accessible (24 hours/7 days).
- reporting instruments and timely data transmission to responsible health authorities established (local, intermediate and national level)
- structured forms of clinical reporting of hospitalized cases
- analysis system of data established
- communication channels with epidemiological services of visitors’ countries established

3.5 Risk assessment

The risk analysis of infectious diseases occurrence at MGs is of particular importance for rational preparation of surveillance system as well as for preventive, mitigation and control measures which have to be prepared and implemented when needed. This is also associated with serious methodological problems: limitations of applying previous experiences to local conditions and difficulties with rational and verifiable risk quantification.

Principles and basic elements of risk assessment should be included in the training. This should contain the following:

a. Definition of risk assessment

b. Definition of risk indicators

c. Measures and exposures used for risk assessment
   i. Prevalence/incidence (host country, visitors countries)
   ii. Prioritisation of infectious diseases under surveillance
   iii. Exposures (including behavioural exposure)

d. Experiences from previous events (literature review, examples)

Risk assessment should start practically from certain important outcomes. These comprise known ones to have occurred on previous MGs or to constitute an epidemiological threat in the country. Identified risks have to be reviewed for their relevance for the mass gathering in question. This narrowly conceived qualitative risk assessment may lead directly 1. to prioritization and 2. to risk management. Other diseases taking local endemicity into account may be included afterwards.

In particular circumstances, the list of anticipated adverse events has to be prepared anew taking local conditions into account. However, rules for reasoning about the risk may be similar in any case. The table attached (Annex 7) presents a simple example of such a reasoning process resulting in a call for action.

Risk matrices are quite useful to compare quantified risks in economics. They are of limited
value if severity of the event is negatively correlated with its frequency. This may be the case when attack rates are used as a measure of outbreak severity (78). Therefore, this toolbox recommends risk matrices to select medical conditions or infectious agents as priorities. The preparation of the surveillance system will not reference incidence or expected number of cases.

Scoring of medical risk presented below is modelled on similar systems presented in recommendations of Australian Emergency Management and partially on the EpiConcept scoring system. To adjust the scores to a simple 5×5 matrix, we suggest using five step scores for disease prioritization: 1. for the expected probability of the event and 2. for its severity:

Hazard probability:

1. Improbable
   a. No occurrence of such diseases or infectious agent was reported ever by surveillance system at mass gatherings.
   b. Such diseases or infectious agent occurs in host country in annual numbers of cases not exceeding 10.
   c. In last five years there was no outbreak of disease evoked by this agent in any of potential visitors countries

2. Seldom
   a. Occurrence of such diseases or infectious agent was reported in less than 10% of reviewed in literature surveillance reports at mass gatherings.
   b. Such diseases or infectious agent occurs in host country in annual numbers of cases not exceeding 100. There were no reported outbreaks of such diseases in host country in the last five years.
   c. In last five years there was no more the 10 outbreaks of disease evoked by this agent in potential visitors countries

3. Occasional
   a. Occurrence of such diseases or infectious agent was reported in less in 10% -50% of reviewed in literature surveillance reports at mass gatherings.
   b. Such diseases or infectious agent occurs in host country in annual numbers of cases >100, ≤1000 or there was reported one outbreak of such diseases in host country in the last five years.

4. Likely
a. Occurrence of such diseases or infectious agent was reported in more than 50%, but not invariably in reviewed literature surveillance reports at mass gatherings.

b. Such diseases or infectious agent occurs in host country in annual numbers of cases exceeding 1000 or there were reported outbreaks of such diseases in host country in the last five years.

5. Frequent
   a. Occurrence of such diseases or infectious agent was reported invariably in reviewed literature surveillance reports at mass gatherings.

Hazard severity:
1. Insignificant
   a. Disease is characterized by minor symptoms, which do not intervene with activities of daily living of infected patients

2. Minor
   a. Disease may limit activities of daily living for up to 7 days.
   b. There is no need for hospitalization
   c. There were no reported fatalities related to this disease

3. Moderate
   a. Disease usually limits activities of daily living for more than 7 days.
   b. There is frequent requirement of bed rest.
   c. There may be need for hospitalization in less the 10% of cases
   d. There were no reported fatalities related to this disease alone. Singular cases fatalities were reported among people with underlying chronic medical conditions.

4. Critical
   a. There is invariable requirement of bed rest.
   b. There may be need for hospitalization in 10% or more then 10% of cases
   c. There were reported fatalities related to this disease alone

5. Catastrophic
   a. Disease meets criteria for critical severity
   b. It has high outbreak potential. Outbreaks were noted in reviewed literature surveillance reports at mass gatherings.
The risk matrix for prioritization of diseases, as outlined above, takes past experience at mass gatherings into consideration. It refers to the characteristic of disease, the epidemiological conditions at the event’s country and to a certain extent of the neighbouring countries. It has a relatively narrow scope since probability of adverse health events’ occurrence depends strongly on the type of event, its duration and size. Besides the disease itself the impact of disease’s occurrence is determined by early detection, availability of healthcare system and its quality. The table below (annex 7) presents a tentative scoring system. It takes the following into consideration: the likelihood of infectious diseases’ occurrence (related to the type of the event) and the potential for the mitigation of its impact (related to medical care system operating at the venue).
CHARACTERISTICS OF THE MASS GATHERING AND SUGGESTED WEIGHTS OF THE RISK OF INFECTIOUS DISEASES

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Risk classification</th>
<th>Score allocation</th>
<th>Event score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of the event</td>
<td>Classical music concert</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Family gathering</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Religious meeting</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sporting event</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Music rock festival</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Number of participants</td>
<td>&lt;2000</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>2001-5000</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5001-10000</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10001-50000</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50001-100000</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;100000</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>Prevalent age group, type of participants</td>
<td>30-65 families</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>30-65 sport fans</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12-16</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>16-30</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Event location, density of participants</td>
<td>Open fields</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Stadiums</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intramural loose crowd</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intramural dense crowd</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Duration of the event</td>
<td>&lt;8h</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>8h-16h (whole day)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Whole day and night</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>More than 1 day and night</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Type of lodging</td>
<td>Outside the event area</td>
<td>1</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>In the event area – hotels, hostels</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>In the event area - camping</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Type of meals</td>
<td>Permanently operating restaurants</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Catering</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Food vendors</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Self preparation</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Availability of alcohol</td>
<td>Restricted</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Available out of the venue</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Available at the venue</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>IVDU</td>
<td>Unlikely</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Limited</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frequent</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Season</td>
<td>Spring /Autumn</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Summer /Winter</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Medical services</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------------------------------------------</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Dedicated net of clinics and hospitals in the area + first aid posts at the venue</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dedicated net of hospitals in the area + first aid posts at the venue</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dedicated net of clinics at the area</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Only first aid posts at the venue</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No dedicated medical facilities</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Total score | Min. 11 | Max. 72 | Exemplary score: 35.5 |
The exemplary score of 35.5 is a medial score which indicates that some measurements have to be taken. Of course closer view to the different categories is necessary. With all reservations regarding arbitrariness of any risk scoring system, including this one, a general risk score provides information on health hazards which organizers and medical service providers may face during the event. This may also serve as a proxy to estimate the burden which may be put on epidemiological and sanitary services. Examples given above have substantial elements of subjective judgement. Readers may change criteria according to their needs. To keep objectivity criteria are set before filling the matrix. The major problem is that those criteria should be logically consistent, i.e. there should not be gaps between categories.

3.6 Assessment of the existing surveillance system and its attributes

3.6.1 Analysis of the existing surveillance system

If we need changes in the existing routine surveillance system derives from the assessment of the planned mass gathering and previous experience of other epidemiologists involved in preparing and operating surveillance systems at mass gatherings. The experience can be from an event similar to the planned one and from review of features of the existing system. The level of enhancement should be based on the comparison of the actual surveillance capacity with the needed or required one. The review of the features of the existing system should cover its structure, technical means and its attributes.

Suggested analysis of the existing surveillance system may be based on the checklist presented below:

- Operation of the system - data collection, processing and disclosure:
  - list and definitions of diseases (conditions) to be reported
  - range of data to be included in single report
  - system of reporting diseases (conditions) – who, to whom by what means
    - alternate sources of epidemiological data
  - who performs compilation and analysis of the data
  - what is the scope of analysis and final product of surveillance
  - integrated system of communication of surveillance data
    - list of recipients of surveillance data, their content and range of distribution
    - system of alert, reaction and control
    - system of public disclosure

- Laboratory capacities
  - number and location of laboratories collaborating with surveillance system
  - their diagnostic potential (diseases and agents covered, quality of available diag-
nostic tests)
  o system of reference
  o system of collection and sending of specimen for testing
  o communication of results (system and timelines)

- General communication system (including exchange of alarm events and epidemiological
  information on international level)
  o parts and partners included
  o means of communication (meetings, media)
  o rules of partnership, order of command
  o rules and authorization for external disclosure

- Ways and means
  o personnel education, skills, experience and motivation
  o personnel training needs and the training program
  o personnel surge capacity
  o infrastructure
  o technical base
  o financial resources

- Evaluation of existing routine surveillance system
  o Is there any operating scheme for evaluation in place?
  o Checking criteria of usefulness
    ▪ detection of trends
    ▪ detection of outbreaks and initiation of control and preventive measures
    ▪ estimating incidence and mortality of diseases reported
    ▪ identification of risk factors and high risk groups
    ▪ assessment of the effects of control measures
  o Checking attributes of the system:
    ▪ simplicity
    ▪ flexibility
    ▪ acceptability
    ▪ sensitivity
    ▪ positive predictive value
      ● fraction of confirmed cases
- representativeness
- timeliness

3.6.2 Assessment of the attributes of the existing surveillance system

Assessment of the surveillance system by critical analysis of its attributes is a particularly recommended approach. Its attributes demonstrate directly the effectiveness of the surveillance system in its practical application. The quality of the surveillance system cannot be expressed in simple linear scale due to a complicated array of different features. It should be rather considered as an interconnected network of features, in some cases conflicting or at least difficult to be improved simultaneously. In a surveillance system, both successes and failures have their special, though rarely unique locations. Both obtaining of epidemiological data and its passage through the system is located in space and takes specified time. Simple graphs may clarify the placement of particular activities and may help to bind attributes with specific structures and actions.

A. Simplicity

Simplicity strongly depends both on the size of the system and on its design. Systems with clear definitions of diseases, limited number of data to be transmitted and clear forms (paper or electronic to be filled) are easy to operate. This assists sensitivity and timeliness of reporting and is usually more flexible than more complicated systems. However, any element of active surveillance has to be introduced on the expense of its simplicity. Also collaboration between clinicians and laboratories performing confirmation tests has to be done on the expense of simplicity. The biggest threat for simplicity is creating numerous additional elements that do not exist in the routine system in place.

For evaluating simplicity concerning particular usefulness are the following parameters:
- amount and type of information required to establish diagnosis according to the requirements of the definition
- data sources – number and types
- means of data transmission
- educational and training requirements of the staff
- range of data analysis
- number of recipients and ways of distribution of reports
- operational effort – time spent by employees on data processing and transmission

B. Flexibility

Flexibility is the ability of the surveillance system to adapt to the new requirements of the system, like inclusion of new diseases or syndromes and enhancement of the diagnostic potential as well as increased level of data analysis. In general simpler systems are more flexible. The best evaluation of flexibility is to include new diseases into the system, or changing requirements for analysis of the data in a trial run.
C. Acceptability

Acceptability means the willingness of medical staff and employed epidemiologists to participate in the system and to achieve good work for it. This feature lays in the work ethics of employees, but may also reflect conviction that set of diseases to be reported has its well founded rationale as well as has set of data to be reported with each case. The acceptability of epidemiologists depends strongly how results of analysis and respective reports are used for public health measures.

D. Sensitivity

Sensitivity is the fraction of occurring cases which was reported in the surveillance system. Error measurement for sensitivity is a fraction of positive cases which are reported as false negative.

In the surveillance system overall sensitivity is a result of three basic steps:
- affected person seeking the contact to the doctor
- ability of the doctor to diagnose the patients condition
- reporting of the condition to the system

In the case of laboratory based surveillance system steps are quite similar:
- affected person seeking the contact to the doctor
- decision of the doctor to sample biological material for test
- ability of the laboratory to detect the agent or serological titter.
- reporting of the result to the system

The easiest step to be evaluated, is the last step because it is based on existing documentation. The first step generally is beyond retrospective evaluation. The intermediate ones are possible to be evaluated but require expensive and time consuming studies which are very difficult to be embedded in the surveillance system. Simple symptomatic or syndromic reporting with easy, computerized data transmission system may have particularly high sensitivity. A stable basic reporting quality serves well for outbreak detection. However, the predictive value positive (PVP) in this type of reporting is notoriously low.

E. Predictive value positive (PVP)

Predictive value positive is the fraction of subjects diagnosed as positive, who are diagnosed correctly. The error of PVP is a fraction which consists of false positive results. PVP is a surrogate indicator of the specificity which cannot be assessed in the surveillance system since the denominator of specificity set of not affected people is not a subject of reporting.

Indispensable condition for assessment of PVP is a sound laboratory system being able to perform confirmation tests of all clinically diagnosed cases. For practical purposes the fraction of patients, who are diagnosed symptomatically and subjected to confirmatory tests, is used as surrogate indicator of specificity in case ascertainment.

F. Representativeness

Representativeness is the reflection of the population’s features in the sample. This poses a very serious problem in sentinel systems, when surveillance is based on different data sources like hospital and ambulatory registers of bills. Real representativeness of data is rarely possible to be assessed in MG’s surveillance since local and visitors’ population is very
difficult to estimate and to characterize. Still surveillance at mass gatherings may be a subject to two important types of bias affecting representativeness:

- Case ascertainment bias: related to different availability of medical services by different groups of participants. For example local people may be diagnosed more thoughtfully then visitors due to communication problems or inequalities in insurance payments.
- Bias in descriptive information about reported cases: caused by communication or confidence problems that are different among different groups of participants.

Those types of bias are difficult to be completely eliminated, though organizers of the surveillance system and in particular of medical services should put special emphasis on the availability of medical care to all participants, providing a non-discriminatory approach to the patients and the possibility to communicate with patients in some basic languages.

G. Timeliness

Timeliness is a measure of the time used for transmission of the epidemiological information in the surveillance system, but also time used for data analysis and time needed for providing and sharing epidemiological information. To a certain extent it may be improved by simple organizational instructions. In comparison with traditional “paper based” systems real improvement was obtained by using computers and special programs adapted to prompt transmission and basic analysis of epidemiological data.

In most reports of surveillance systems operating at major sporting events, timeliness was improved by switching from weekly to daily reporting. In some cases computerized systems allowed almost continuous real time reporting.

Overview of resources (including existing system of epidemiological surveillance and means of reporting)

1. Existing routine surveillance system (this is already described in detail above)

2. Existing system of sanitary supervision

- Environmental hygiene
  - responsibilities and functioning of Municipal Hygiene Office in the area
  - responsibilities and functioning of environmental hygiene body at the venue
  - rules of cooperation between them and hierarchy of responsibilities

- Food hygiene
  - system of supervision food hygiene in the area and at the venue
    - available personnel and surge capacities
- laboratory facilities
- assessment of the condition of food hygiene in the area (restaurants, bars, food vendors)
- what are the plans to adjust the system to increased burden at the time of mass gathering?
- system of supervision of food hygiene at the venue
- available personnel (number, skills, administrative powers and responsibilities)
- what is its relation to municipal food hygiene authorities?
- does the system of licensing catering and food vendors include assessment of:
  - staff training and staff health control
  - food handling
  - food storage (refrigeration capacity and order)
  - wholesale sources of food
  - food transport
  - serving or packaging and labelling
  - cleaning and sanitizing
  - solid and fluid waste disposal at the places of food preparation and consumption
  - written undertaking to comply with their commitments

- Supervision of compliance of food providers to hygienic rules and regulations during the event
  - proposed frequency of controllers visits
  - set of critical control points
3.7 Analysis of gaps of the existing surveillance system as basis for decision on design of surveillance system needed for specific mass gathering

3.7.1 Assessment of needs

Needs are not the absolute term. Assessment of needs is a comparison of the challenges and the capabilities to find gaps between the two and overcome them. The preparation of epidemiological surveillance at mass gatherings is challenged by the size of the meeting, and its features which determine the range of the basic epidemiological activity. We also have to be prepared for an additional burden emerging from the risks associated with the event. Final effects of those risks may be only partially predictable. To minimize this expected burden we have to check the following inventory:

- Available personnel and surge capacity in case of extra burden
  - Education, competences for epidemiological analysis
  - Professional experience in epidemiological surveillance
  - Availability for overtime work
  - Sources of payment

- Actual basis of the surveillance system
  - Its material base including computers, computer program and communication facilities
  - Its flexibility and improvement potential including adaptability to the conditions of mass gathering analyzed for all of its attributes
  - Laboratory base and its ability to perform additional number of diagnostic tests in required time
  - Range of infections, infectious diseases, and syndromes covered

All features of existing surveillance systems have to be checked for their adequacy to the conditions of particular mass gatherings. On this basis it should be decided whether the system requires strengthening, this strengthening may be done within the system or requires extra investment. Financial requirements need to be formulated as precisely as possible to avoid exaggerated demands. It also concerns training needs of the basic and accessory personnel. Strengthening of the surveillance system is not the sole source for the needs. Epidemiological surveillance at mass gatherings remains within wider context of expectations of administrative authorities and international bodies. Its results may be of importance to those institutions. Also international sources of information may be of great value for risk assessment.

This is why assessment of needs should include communication within the venue, within the country and also on international level. With limited resources it would be important to prioritize the needs and to allocate expenses to the most important improvements.
3.7.2 Design of surveillance system for specific mass gathering

In order to design a system of enhanced surveillance all available information itemized above may be collected and integrated, providing the basis for further planning. The preliminary design may be based on previous experiences of successful surveillance at different large events in different countries. Such an outline may be gradually clarified and specified along the assessment of the gathering itself, the analysis of the existing infrastructure, the existing surveillance system as well as the assessment of the most fundamental and predictable risks. Assessment of gaps in the system is the indispensable source for identifying needs. The analysis of the checklists in different stages of the assessment of existing and expected conditions at the venue and in the area would be a constant source of data, necessary for modifying the design of enhanced surveillance system.

Preparation of surveillance systems for mass gatherings or development of amendments to the existing system should always include the analysis of the following elements:
- Timeliness, ability for daily reporting, and instant reporting of alarming events
- Ability for early outbreak detection and outbreak control
- Ability for detection of particularly dangerous diseases or agents
- Flexibility allowing to introduce new events
- Continuous assessment of the system attributes with special reference to its sensitivity and predictive value positive.

Particularly important is that the assessment of the needs provides the purpose and the range of required enhancement of existing surveillance systems. In reviews with experts the need for a careful selection of conditions under surveillance was specifically highlighted: improved timeliness of reporting and analysis, and also the problem of setting thresholds for signals. We believe that equally important as alarm thresholds is the preparation of individual persons and procedures for dealing with that alarm. This preparation should be included in the training and exercises performed prior to the event.

3.7.3 Evaluation of performance

Before, during and after the event a system for evaluation of some basic attributes of surveillance system should be in place. Among the attributes to be assessed the following should be invariably: sensitivity, positive predictive value and timeliness as well as its ability for detection of outbreaks.

Before the event the surveillance system cannot operate in the conditions comparable with those at the event. It is highly advisable to include field exercises in the training. Those exercises could help finding gaps in the structure of surveillance and imperfect performance of staff.

Any setup for evaluation requires trained personnel and absorbs time and resources, which may be very tight during events. Therefore, expectations concerning evaluation system superimposed on the surveillance should be measured very carefully. It should be also remembered that information on some attributes of the system like timeliness may emerge directly
from the way data are obtained. Sensitivity may be checked when different information sources are compared. The positive predictive value correlates well with the fraction of laboratory confirmed cases. Managers of surveillance system should sensitize themselves to signals indicating the improper functioning of the surveillance and at the same time should have means to respond to these signals. 

The acceptance of participating stakeholders is crucial for the effectiveness of the evaluation system; therefore it would be highly advisable to get an agreement of the participants of the system in advance before it is introduced at the event. Post-event assessment of its performance is necessary for future applications. Data from medical facilities within the country and also from abroad may confirm the quality of surveillance, but also may expose its inadequacies. Sources of information and proper communication channels should be prepared at the stage of system’s organization for an expedient post-event assessment. International contacts should be established with WHO and ECDC as well as with departments of health of the countries whose residents participated in the event.
4 Annexes

4.1.1 Annex 1. Checklist for the assessment of a mass gathering event

A. The event:

- The type of the event (purpose of gathering, expected activities)
  - Indoor/outdoor
  - Free movement of visitors/fixed standing or sitting
- The size
- Number of visitors
- Are there any satellite events at the same premises or in the same town/village
- Type/age of visitors
- Duration of the event (day and hour of start and conclusion)
- Expected hazards at the event
  - Drugs
  - Alcohol
  - Aggression (Potential for riots)

B. The venue:

- Premises
  - Performance hall
  - Stadium
  - Court
  - Meadows
  - Availability of map/plan
- Traffic and transportation plan
  - Transportation means and staff service vehicles
  - Roads/parking
  - Gates, marking of escape routes
  - Access for emergency units
  - Access for disabled persons
- Security and crowd management
  - Compartmentation of the different groups of participants
• Structure of communication system – is it available for the surveillance needs?

• Hygienic and sanitary utilities, their sufficiency and availability
  o Drinking water fountains
  o Water taps & sinks
  o Urinals
  o Toilet bowls

• Waste collection and disposal system

• Fire resistance of premises, fire fighting preparation

• Management of premises – communication, chain of command and responsibility

C. Base and organization of medical services

• First aid posts at the venue
  o Location and availability (mapping, routes)
  o Range of provided help
  o Utilization for reporting in surveillance system
  o System of financing

• Emergency services at the venue
  o Location and availability
  o Range of provided help and transportation
  o Utilization for reporting in surveillance system
  o System of financing

• Medical clinics in the area
  o Location and availability (mapping)
  o Range of provided help
  o Utilization for reporting in surveillance system
  o System of financing/insurance

• Hospitals in the area
  o Location and availability (mapping)
  o Range of provided help
  o Utilization for reporting in surveillance system
  o System of financing/insurance
- Laboratories
  - Hospital based
    - Number
    - Range of diagnostic microbiology tests
    - Utilization for reporting in surveillance system
  - Other laboratories
    - Number
    - Range of diagnostic microbiology tests
    - Utilization for reporting in surveillance system
  - System of quality control – reference laboratories
  - System of financing/insurance
4.1.2 Annex 2-1. List of major infectious diseases

Gastrointestinal diseases

1. Salmonellosis
2. E. coli-infection
3. Campylobacter infection
4. Shigellosis
5. Staphylococcal food poisoning
6. Hepatitis A
7. Norovirus infection
8. Gastrointestinal infection – unspecified

Respiratory diseases

1. Influenza
2. Avian influenza
3. Legionellosis

Vaccine preventable diseases

- Measles
- Meningococcal disease

Locally endemic infectious diseases

- Q fever
- Leptospirosis

Intentionally release pathogens/toxins (see annex 2-2)

- Anthrax
4.1.3  Annex 2-2. The list of bioterrorism agents/diseases according to CDC


Category A
Definition: The U.S. public health system and primary healthcare providers must be prepared to address various biological agents, including pathogens that are rarely seen in the United States. High-priority agents include organisms that pose a risk to national security because they:

- can be easily disseminated or transmitted from person to person;
- result in high mortality rates and have the potential for major public health impact;
- might cause public panic and social disruption; and
- require special action for public health preparedness.

Agents/Diseases
- Anthrax (Bacillus anthracis)
- Botulism (Clostridium botulinum toxin)
- Plague (Yersinia pestis)
- Smallpox (Variola major)
- Tularemia (Francisella tularensis)
- Viral hemorrhagic fevers (filoviruses [e.g. Ebola, Marburg] and arenaviruses [e.g. Lassa, Machupo])

Category B
Definition: Second highest priority agents include those that

- are moderately easy to disseminate;
- result in moderate morbidity rates and low mortality rates; and
- require specific enhancements of CDC’s diagnostic capacity and enhanced disease surveillance.

Agents/Diseases
- Brucellosis (Brucella species)
- Epsilon toxin of Clostridium perfringens
- Food safety threats (e.g. Salmonella species, Escherichia coli O157:H7, Shigella)
• Glanders (Burkholderia mallei)
• Melioidosis (Burkholderia pseudomallei)
• Psittacosis (Chlamydia psittaci)
• Q fever (Coxiella burnetii)
• Ricin toxin from Ricinus communis (castor beans)
• Staphylococcal enterotoxin B
• Typhus fever (Rickettsia prowazekii)
• Viral encephalitis (alphaviruses [e.g. Venezuelan equine encephalitis, eastern equine encephalitis, western equine encephalitis])
• Water safety threats (e.g. Vibrio cholerae, Cryptosporidium parvum)

**Category C**

Definition: Third highest priority agents include emerging pathogens that could be engineered for mass dissemination in the future because of

• availability;
• ease of production and dissemination; and
• potential for high morbidity and mortality rates and major health impact.

Agents

• Emerging infectious diseases such as Nipah virus and hantavirus
• Content source: National Centre for Environmental Health (NCEH)/Agency for Toxic Substances and Disease Registry (ATSDR), Office of Non-communicable Diseases, Injury and Environmental Health, National Centre for Chronic Disease Prevention and Health Promotion (NCCDPHP), National Centre on Birth Defects and Developmental Disabilities (NCBDDD)
<table>
<thead>
<tr>
<th>Syndrome</th>
<th>Definition</th>
<th>Category A Condition</th>
</tr>
</thead>
</table>
| Botulism-like                  | ACUTE condition that may represent exposure to botulinum toxin  
ACUTE paralytic conditions consistent with botulism: cranial nerve VI (lateral rectus) palsy, ptosis, dilated pupils, decreased gag reflex, media rectus palsy.  
ACUTE descending motor paralysis (including muscles of respiration)  
ACUTE symptoms consistent with botulism: diplopia, dry mouth, dysphagia, difficulty focusing to a near point. | Botulism            |
| Hemorrhagic Illness            | SPECIFIC diagnosis of any virus that causes viral hemorrhagic fever (VHF): yellow fever, dengue, Rift Valley fever, Crimean-Congo HF, Kyasanur Forest disease, Omsk HF, Hantaan, Junin, Machupo, Lassa, Marburg, Ebola  
ACUTE condition with multiple organ involvement that may be consistent with exposure to any virus that causes VHF  
ACUTE blood abnormalities consistent with VHF: leukopenia, neutropenia, thrombocytopenia, decreased clotting factors, albuminuria | VHF                 |
| Lymphadenitis                  | ACUTE regional lymph node swelling and/or infection (painful bubo - particularly in groin, axilla or neck)                                                                                                      | Plague (Bubonic)    |
| Localized Cutaneous Lesion     | SPECIFIC diagnosis of localized cutaneous lesion/ ulcer consistent with cutaneous anthrax or tularemia  
ACUTE localized oedema and/ or cutaneous lesion/ vesicle, ulcer, eschar that may be consistent with cutaneous anthrax or tularemia  
INCLUDES insect bites  
EXCLUDES any lesion disseminated over the body or generalized rash  
EXCLUDES diabetic ulcer and ulcer associated with peripheral vascular disease | Anthrax (cutaneous)  
Tularemia            |
| Gastrointestinal              | ACUTE infection of the upper and/ or lower gastrointestinal (GI) tract  
SPECIFIC diagnosis of acute GI distress such as Salmonella gastroenteritis  
ACUTE non-specific symptoms of GI distress such as nausea, vomiting, or diarrhoea | Anthrax (gastrointestinal) |
| **EXCLUDES** any chronic conditions such as inflammatory bowel syndrome |  |
4.1.5 Annex 3. Options for surveillance

(1) Routine surveillance

(2) Enhanced routine surveillance
   - Accelerated data transmission
   - Event-based surveillance
   - Introduction of an additional free-text reporting (apart from the pre-existing definition based)
   - Monitoring of domestic and international media sources
   - Strengthening of communication and interaction between different public stakeholders within the country and abroad.

(3) Laboratory-based surveillance
(4) Syndromic surveillance
(5) Event-based surveillance
   - over-the-counter drug sales
   - absenteeism
### 4.1.6 Annex 4. Risk matrix for prioritization of disease

<table>
<thead>
<tr>
<th>Hazard severity</th>
<th>Hazard probability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Improbable</td>
</tr>
<tr>
<td>Catastrophic</td>
<td></td>
</tr>
<tr>
<td>Critical</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td></td>
</tr>
<tr>
<td>Minor</td>
<td></td>
</tr>
<tr>
<td>Insignificant</td>
<td></td>
</tr>
</tbody>
</table>

**Legend:**
- Red: High priority
- Purple: Medium priority
- Blue: Low priority
- Green: No priority – below tolerance line
4.1.7 Annex 5. Checklist of criteria to assess the existing surveillance system

- Operation of the system - data collection, processing and disclosure:
  - list and definitions of diseases (conditions) to be reported
  - range of data to be included in single report
  - system of reporting diseases (conditions) – who, to whom by what means
    - alternate sources of epidemiological data
  - who performs compilation and analysis of the data
  - what is the scope of analysis and final product of surveillance
  - integrated system of communication of surveillance data
    - list of recipients of surveillance data, their content and range of distribution
    - system of alert, reaction and control
    - system of public disclosure

- Laboratory capacities
  - number and location of laboratories collaborating with surveillance system
  - their diagnostic potential (diseases and agents covered, quality of available diagnostic tests)
  - system of reference
  - system of collection and sending of specimen for testing
  - communication of results (system and timelines)

- General communication system (including exchange of alarm events and epidemiological information on international level)
  - parts and partners included
  - means of communication (meetings, media)
  - rules of partnership, order of command
  - rules and authorization for external disclosure
• Ways and means
  o personnel education, skills, experience and motivation
  o personnel training needs and the training program
  o personnel surge capacity
  o infrastructure
  o technical base
  o financial resources

• Evaluation of existing routine surveillance system
  o Is there any operating scheme for evaluation in place?
  o Checking criteria of usefulness
    ▪ detection of trends
    ▪ detection of outbreaks and initiation of control and preventive measures
    ▪ estimating incidence and mortality of diseases reported
    ▪ identification of risk factors and high risk groups
    ▪ assessment of the effects of control measures
  o Checking attributes of the system:
    ▪ simplicity
    ▪ flexibility
    ▪ acceptability
    ▪ sensitivity
    ▪ positive predictive value
    ▪ representativeness
    ▪ timeliness
4.1.8  Annex 6. Checklist to assess needed resources

- Available personnel and surge capacity in case of extra burden
  - Education, competences for epidemiological analysis
  - Professional experience in epidemiological surveillance
  - Availability for overtime work
  - Sources of payment

- Actual basis of the surveillance system
  - Its material base including computers, computer program and communication facilities
  - Its flexibility and improvement potential including adaptability to the conditions of mass gathering analyzed for all of its attributes
  - Laboratory base and its ability to perform additional number of diagnostic tests in required time
  - Range of infections, infectious diseases, and syndromes covered
### 4.1.9 Annex 7. Characteristics of the mass gathering and suggested weights of the risk of infectious diseases

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Risk classification</th>
<th>Score allocation</th>
<th>Event score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of the event</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classical music concert</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Family gathering</td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Religious meeting</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Sporting event</td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Music rock festival</td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Number of participants</td>
<td>&lt;2000</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2001-5000</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5001-10000</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10001-50000</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50001-100000</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;100000</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>Prevalent age group, type of participants</td>
<td>30-65 families</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30-65 sport fans</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12-16</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>16-30</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Event location, density of participants</td>
<td>Open fields</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stadiums</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intramural loose crowd</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intramural dense crowd</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Duration of the event</td>
<td>&lt;8h</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8h-16h (whole day)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Type of lodging</td>
<td>Whole day and night</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>-------------------------</td>
<td>---------------------</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td></td>
<td>More than 1 day and night</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Type of lodging</td>
<td>Outside the event area</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>In the event area – hotels, hostels)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>In the event area - camping</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Type of meals</td>
<td>Permanently operating restaurants</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Catering</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Food vendors</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Self preparation</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Availability of alcohol</td>
<td>Restricted</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Available out of the venue</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Available at the venue</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>IVDU</td>
<td>Unlikely</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Limited</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frequent</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Season</td>
<td>Spring /Autumn</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Summer /Winter</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Medical services</td>
<td>Dedicated net of clinics and hospitals in the area + first aid posts at the venue</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dedicated net of hospitals in the area + first aid posts at the venue</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dedicated net of clinics at the area</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Only first aid posts at the venue</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No dedicated medical facilities</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Total score</td>
<td>Min. 11</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Max.72</td>
<td></td>
<td></td>
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