

Public health strategies for mass gathering events: A focus on the Milan–Cortina 2026 Olympic and paralympic winter games

ANDREA DA RECH¹, VINCENZO MARCOTRIGIANO¹, ANNA VOLTOLINI¹, MATTIA MANZI¹, NAHUEL FIORITO¹, MARICA BATTISTIN¹, MARIA PARPINEL², SANDRO CINQUETTI¹

¹Prevention Department, Local Health Authority “ULSS 1 Dolomiti”, Belluno, Italy; ²Department of Medicine, University of Udine, Udine, Italy.

ABSTRACT

Introduction: Mass gatherings, such as the Milan–Cortina 2026 Olympic and Paralympic Winter Games, have potential implications for infectious diseases, food safety and environmental hygiene. In this setting, the Local Health Authority ULSS 1 Dolomiti has developed an integrated public health preparedness model that includes Cortina d’Ampezzo and its surrounding areas.

Methods: An operational model was structured by the Prevention Department around three priority areas for intervention: (i) infectious diseases and epidemiological surveillance, including the implementation of syndromic and event-based systems by a dedicated public health team; (ii) food safety, with a strengthened programme of official controls and a shared food safety policy for business operators; and (iii) public health and environmental hygiene, including drinking water monitoring, *Legionella spp.* detection in tourist accommodation facilities, and developing a microbiological wastewater surveillance protocol (wastewater-based epidemiology).

Results: Between January and August 2025, 44 inspections were carried out in food businesses, identifying non-compliance mainly in the areas of structural and hygiene/organizational issues and cleaning and sanitization procedures. From January 2024 to June 2025, 60 water samples were collected to verify compliance with potability requirements; a limited proportion of samples required follow-up investigations, with no formal non-compliance detected that exceeded the legal limits. The investigation of seven accommodation facilities included 26 samples for *Legionella spp.* screening; positive results—and thus the need to implement corrective actions—were found in three facilities.

Conclusions: In light of the preliminary evidence arising from our investigation, Cortina d’Ampezzo’s pre-Olympic experience suggests that Olympic preparedness can strengthen local public health, enhancing legacy, prevention,



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Correspondence: Vincenzo Marcotrigiano / Prevention Department, Local Health Authority “ULSS 1 Dolomiti”, 32100 Belluno, Italy. / E-mail: vincenzo.marcotrigiano@aulss1.veneto.it

ORCID: 0009-0003-9971-7721

coordination and response capacities among healthcare workers and the various institutions and organizations involved. The adoption of a preparedness model depicts a best practice for replication in other mass gathering settings, with potential long-term benefits for protecting public health and increasing the health system's response capacity.

Key words: public health surveillance, food safety and environmental hygiene, olympic and paralympic games, mass gathering health preparedness.

Introduction

Mass gatherings represent a complex challenge for host countries, particularly for their health systems. The experiences of the Athens 2004 and London 2012 Olympic Games highlighted the need to integrate epidemiological surveillance, food safety and environmental controls within a single governance framework. Such measures curate a system capable of rapidly reacting to risk signals, generating a lasting legacy for national prevention systems (1-5). More recently, the Tokyo 2020 and Beijing 2022 Olympic Games, both held during the COVID-19 pandemic, underscored the importance of flexible preparedness models based on advanced surveillance, wastewater analysis and targeted control measures designed to ensure event safety (6-9). At the same time, numerous studies have drawn attention to the role of accommodation facilities and their water distribution systems as potential *Legionella spp.* reservoirs, particularly in areas with high levels of tourism (10-14). In the Milan-Cortina 2026 Olympic and Paralympic Winter Games, Cortina d'Ampezzo is one of the four main competition venues, located in the North-East of Italy in a mountain area characterized by substantial seasonal tourist flows. Starting in 2024, within the framework of Olympic health organization—of which public health is a central component—the Prevention Department of the Local Health Authority ULSS 1 Dolomiti (ULSS 1 Dolomiti) initiated the planning and implementation of an integrated public health model, with the aim of both managing the Games and structurally strengthening the local system. More specifically, the main pre-Olympic test events held in Cortina d'Ampezzo in 2025 were used

as testing grounds to assess the effectiveness of procedures, information flows and coordination capacity. The Games will be held in February and March 2026 in multiple venues spanning the Veneto and Lombardy Regions and the Autonomous Provinces of Trento and Bolzano. The aim of this investigation is to describe the health preparedness model developed by the Prevention Department of ULSS 1 Dolomiti for Cortina d'Ampezzo, to share the preliminary test event results—with a particular focus on food safety and environmental hygiene—and to discuss the public health practice implications in light of the Milan-Cortina 2026 Olympic and Paralympic Winter Games.

Methods

In preparation for the Milan-Cortina 2026 Olympic and Paralympic Winter Games, the ULSS 1 Dolomiti, in coordination with the Veneto Region, has developed an organizational framework dedicated to protecting public health and managing event-associated health risks. This model is based on the principles of preparedness and readiness, in accordance with the *Olympic Games Guide – Medical Services* issued by the International Olympic Committee and with the contents of Veneto Regional Government Resolution no. 127/2025, which sets out the strategic and operational guidelines for public health during the Games (15,16). The methodological framework adopted is structured around prevention, inter-institutional coordination and continuous quality improvement, with the aim of ensuring healthcare provision across distinct levels: for athletes and their staff, for the workers involved in various capacities in the Games, and for the resident population

in the Olympic territories. In this context, public health is understood as a transversal and integrated function, ensuring, coordinating and primarily overseeing the following areas: infectious diseases and epidemiological surveillance, food safety and environmental hygiene.

Infectious disease surveillance and control

For infectious disease surveillance and control, a procedure based on syndromic and event-based surveillance was conceived and approved to strengthen monitoring and early response. A public health team was set up, comprising a medical officer and a nurse and/or health visitor, and tasked with managing potential outbreaks through conducting epidemiological investigations and contact tracing. In line with the European Centre for Disease Prevention and Control (ECDC) recommendations, immunochromatographic tests will be used to support SARS-CoV-2/influenza A and B, respiratory syncytial virus, norovirus, rotavirus/adenovirus, *Legionella spp.* and group A Streptococcus detection and diagnosis (17). In addition, with the support of the Italian National Institute of Health, healthcare workers (HCWs) of the Prevention Department of ULSS 1 Dolomiti have been trained in managing and analyzing event-based surveillance through the Epidemic Intelligence from Open Sources (EIOS) system.

Food safety

Regarding food safety, a working group was established to develop a shared protocol among the health authorities responsible for the Olympic Games territories. This protocol includes a food safety policy and an operational handbook for food business operators (FBOs). The aim was to identify minimum structural and hygiene–sanitary requirements to safeguard public health and ensure food and beverage safety in a highly complex setting characterized by large population inflows and the presence of numerous temporary and/or mobile food service activities, particularly food trucks.

An intensified inspection programme was also implemented in public food businesses in the Cortina d'Ampezzo municipality, mainly focusing on those near test event venues and those most affected by tourist flows. Between January and August 2025, 44 official controls were carried out in food establishments in the Cortina

d'Ampezzo municipality. Most inspection interventions were targeted to restaurants, bars serving food, and food service activities within tourist accommodation facilities (e.g., hotels), reflecting the central role of the area under investigation. The dataset analyzed includes all official inspections performed during the period; for each visit, it includes records of establishment type, the reason for the intervention, and any non-compliances identified and corrective actions required. In line with approaches adopted in other Olympic settings, non-compliances were grouped into broad categories (2,3).

Environmental hygiene

DRINKING WATER CONTROL

As a Games preparedness measure, since January 2024, drinking water control has been strengthened. These activities fall within the monitoring plan laid down by Legislative Decree 18/2023 and integrate routine controls with additional targeted sampling in areas most affected by tourist flows and test events (18). For this investigation, samples collected between January 2024 and June 2025 within the Cortina d'Ampezzo municipal territory were assessed. For each sample, microbiological and chemical parameters in groups A and B, as defined by the above-mentioned Decree, were analyzed according to established methods. All samples were assessed by the Regional Agency for Environmental Protection and Prevention of Veneto (ARPAV), the reference laboratory. After the implementation of specific corrective measures, samples demonstrating management anomalies or values close to regulatory limits were subjected to follow-up.

Environmental legionella spp. surveillance in accommodation facilities

An environmental investigation was conducted in 7 accommodation facilities among those designated to host delegations and visitors during the Games. The investigation, which was carried out in 2025, included technical site inspections and domestic hot water sampling at representative points of the systems (tanks, recirculation circuits, and distribution pipeline terminals).

Samples were analyzed by ARPAV to detect *Legionella spp.* by culture, with results expressed as

CFU/L. We classified contamination levels according to national reference thresholds, and distinguished compliant and non-compliant samples with additional concentration subclasses.

Wastewater-based epidemiology

Within the broader framework of environmental hygiene, a protocol for microbiological wastewater-based epidemiology (WBE) is being developed in collaboration with ARPAV and the University of Padua. This protocol involves sampling at strategic points of the Cortina d'Ampezzo sewer network, including the Olympic villages and sites located near the main urban wastewater treatment plant. The aim is to enable the early detection of selected pathogens of interest (particularly respiratory and enteric viruses), in line with experiences from the Tokyo 2020 and Paris 2024 Games (19). As of December 2025, only design elements are available; however, we will begin collecting operational data approximately one month before the Games commence.

Results

Food safety

The analysis related to official controls shows that the most frequent issues concerned structural

conditions (46.3%), such as inadequate working environments, poorly maintained systems or insufficient space to ensure appropriate workflow. These were followed by non-compliances related to staff and process hygiene (21.3%), including inadequate handwashing procedures, improper use of personal protective equipment and cross-contamination between raw and cooked foods (20). Cleaning and sanitization accounted for 10.1% of non-compliances, while Hazard Analysis and Critical Control Points (HACCP) and storage/transport each represented 7.6%. Although less frequent (3.0%), non-compliance in terms of allergen management nonetheless highlighted room for improved consumer communication (Figure 1).

Drinking water control

Between January 2024 and June 2025, ULSS 1 Dolomiti—the competent authority for external controls—collected 60 drinking water samples in the Cortina d'Ampezzo municipality. Of these, 11.6% (seven samples) required follow-up, mainly due to management anomalies (such as transient increases in bacterial count at 22°C or changes in turbidity or residual chlorine), with parameters within normal ranges after subsequent checks. The quarterly trend in the proportion of samples requiring follow-up shows

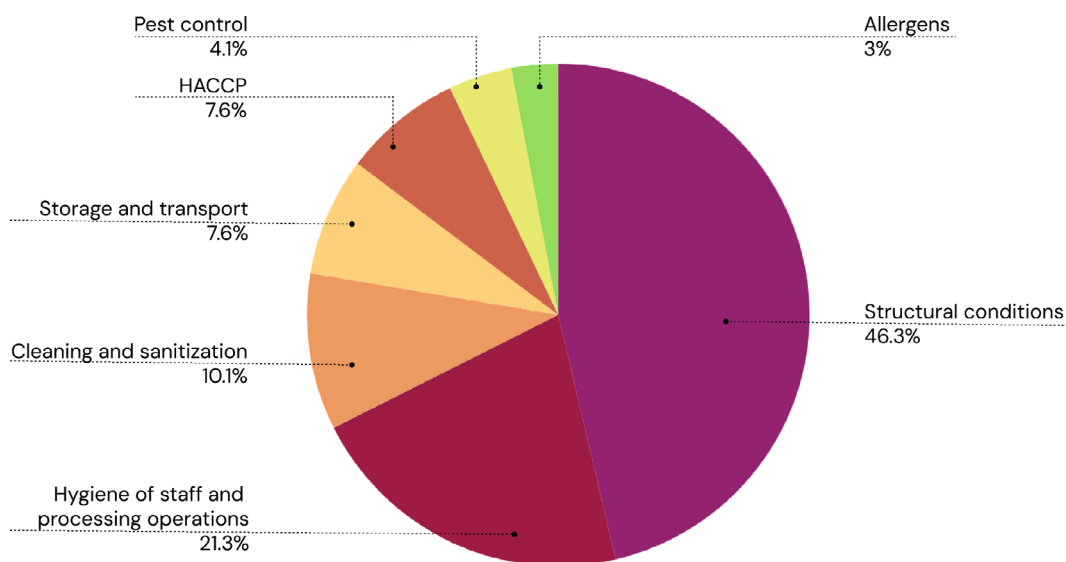


Figure 1. Distribution of non-compliances identified during official controls.

a progressive decrease, with higher values in the initial phase that subsequently approach zero (Figure 2).

This trend suggests increased management stability and improvement in the overall quality of the water supply network, likely attributed to the technical interventions implemented by the operators in 2024–2025.

Legionella spp. investigation in accommodation facilities

An environmental investigation was conducted across seven accommodation facilities, collecting 26 domestic hot water samples. Overall, 4/26 samples were positive for *Legionella spp.* (15.4%), originating from 3/7 facilities (42.9%). Conversely, 22/26 samples were compliant (84.6%, <100 CFU/L), indicating that contamination was not widespread across all venues, but rather clustered within a subset of locations. Among the positive results, 1/26 samples (3.9%) fell within the 101–1,000 CFU/L range, whereas 3/26 (11.5%) were in the 1,001–10,000 CFU/L range. Quantitative values for the positive samples ranged from 800 to 4,000 CFU/L (800, 1,000, 3,400, and 4,000 CFU/L). At facility level, positivity rates among the three facilities with at least one positive sample

were 25.0% (1/4, *Facility 1*), 66.7% (2/3, *Facility 2*), and 33.3% (1/3, *Facility 3*), corresponding to a positivity range of 2566.7% across facilities with positive findings; the remaining four facilities not showing any positivity. Overall, these results highlight heterogeneity between facilities, supporting the value of facility-specific monitoring and targeted corrective actions rather than assuming a uniform risk across all venues.

Discussion

Thus far, experiences in Cortina d'Ampezzo show that the preparation phase for mass gathering events can be useful for systematically strengthening local public health systems. Reinforcing the surveillance of food, drinking water and accommodation facilities makes it possible to achieve the following:

- The early identification of structural and managerial weaknesses, meaning corrective measures can be implemented before the expected increase in tourist load;
- The standardization of protocols and information flows across different services: Food Hygiene

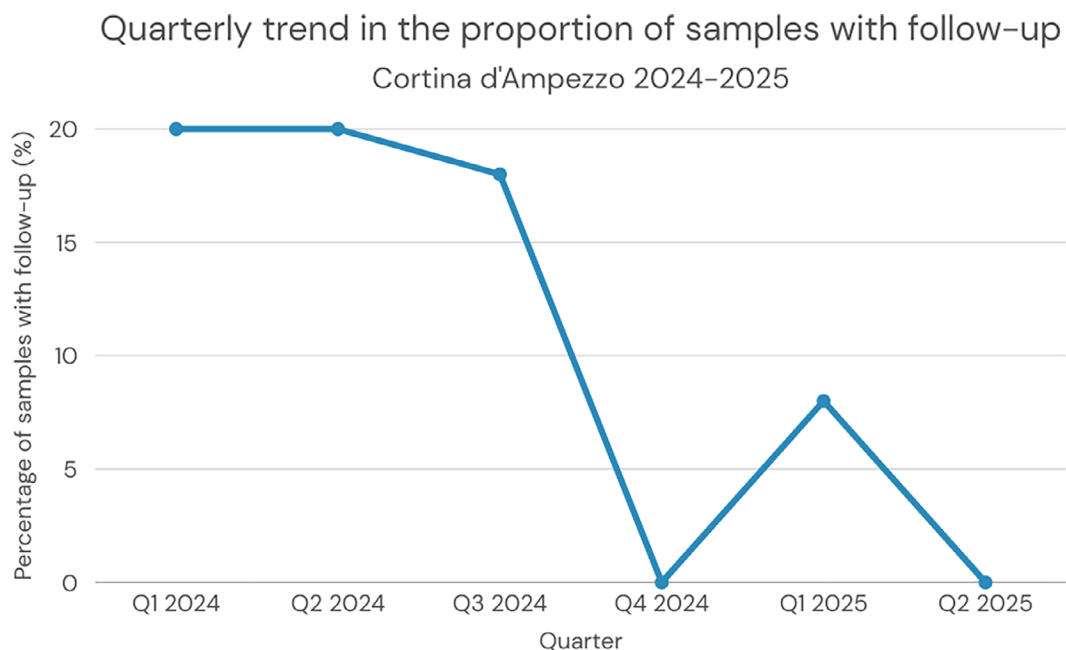


Figure 2. Quarterly trend of samples requiring follow-up.

and Nutrition Service (SIAN), Hygiene and Public Health Service (SISP), water utilities, and accommodation facilities), ensuring methodological consistency;

The building of expertise and strengthening of inter-institutional relationships, both of which will remain territorial assets after the Games have ended.

In the context of mass gatherings, the preliminary results described here are consistent with international evidence highlighting the role of preventive official controls not only as a verification tool but also as an instrument for operator guidance and training, with particularly measurable effects on food safety-related operational procedures, including awareness of new types of foods (2,3,20,21,22). Likewise, targeted environmental surveillance for *Legionella spp.* detection in accommodation fits within a well-established body of literature showing that such facilities may act as potential risk reservoirs without adequate prevention plans. Where necessary, in light of our findings the SISP of ULSS 1 Dolomiti requested that the operators implement corrective measures, including system remediation (thermal shock or chemical treatment), maintenance plan revisions and subsequent verification checks. Although the proportion of positive samples was limited, the findings are consistent with reports from other Italian and European tourist settings, where the colonization of hotel water systems by *Legionella spp.* is not uncommon and structured surveillance programmes and preventive maintenance are required (10-12). Looking ahead, integrating these interventions within syndromic surveillance and innovative systems—such as wastewater microbiological surveillance and rapid point-of-care tests for infectious diseases—may enhance early warning signal detection and management (6,17,8,15), especially in light of the growing efforts that Public Health must ensure for the full implementation of this line of work (23). The results achieved during the preparedness phase are useful for creating a baseline necessary for comparing the data we will have available during the Olympic and Paralympic Games and for promptly managing any early warnings. Currently, taking into account the provisions of the International Olympic

Committee, we improved the internal procedures dealing with the infectious disease surveillance and control and WBE. Furthermore, with the Lombardy Region and Autonomous Provinces involved in this widespread edition of the Games, we are univocally structuring the bulletins, to evaluate the epidemiological trend on a daily basis.

Experiences from London 2012, Tokyo 2020 and Beijing 2022 indicate that syndromic surveillance, as well as the structured use of environmental indicators, can contribute to the sustained strengthening of public health systems (1,4,6,8). To the best of our knowledge, this is the first study to describe the preliminary public health outcomes of the Olympic area testing period. Although the limited sample size and the absence of a structured pre-post comparison study design, the evidence described here seems to be useful for ensuring better preventive healthcare in Olympic settings, for reorienting the methods and techniques to be adopted along specific operational lines in a timely manner, and for guaranteeing better service quality to protect the community.

Conclusions

From an operational perspective, experiences in Cortina d'Ampezzo to date suggest several useful recommendations for other territories involved in major mass gatherings:

- Authorities must plan surveillance systems well in advance, using data from the years preceding the event to build time series and consolidate control networks;
- They must integrate food and drinking water safety and environmental hygiene within a single governance framework;
- They must invest in innovative surveillance systems, such as WBE and rapid point-of-care tests, as a complement to syndromic event-based systems;
- Finally, they must strengthen training and communication among HCWs so that non-compliances become opportunities for rapid improvement.

In this way, Olympic preparedness does not end with the management of a time-limited event, but contributes to building a more resilient health system, modeling best practice for replication in other mass gathering settings (24). The long-term impacts constitute a methodological and operational legacy that can be adopted by HCWs to both protect public health and enhance system response capacity in highly complex scenarios (25). In the case of Cortina d'Ampezzo, the use of pre-Olympic test events as a "full-scale rehearsal" made it possible to validate protocols and procedures under real-world conditions. In this way, a body of knowledge has been generated that is transferable to other settings, turning preparedness from a planning exercise into an operational practice for structural system improvement.

Conflict of Interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

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