Postprint: Closed-Loop Management Strategy for Nosocomial Infection Prevention and Control in Designated Dental Hospitals Treating Olympic-Related Dental Emergency Patients During the Winter Olympics and Paralympics

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Abstract

During the 2022 Beijing Winter Olympic Games (hereinafter referred to as the Winter Olympics) and Winter Paralympic Games (hereinafter referred to as the Winter Paralympics), our hospital served as the designated oral healthcare institution for Olympic-related patients. Nosocomial infection control represented a formidable challenge during the Winter Olympics (and Paralympics). The hospital established dedicated isolation passages and independent consultation rooms for Olympic-related patients and medical staff, referencing infection prevention and control standards for emergency departments in specialized stomatology hospitals and incorporating COVID-19 pandemic considerations. A total of 6 medical staff members (organized into 3 groups, each comprising 1 physician and 1 nurse) entered the closed-loop system and worked in shifts, achieving a 100.00% training qualification rate. Medical staff strictly implemented personal protective measures before, during, and after treatment, and diagnosis and treatment areas (including surfaces and reusable medical instruments) underwent rigorous disinfection. The hospital treated 38 Olympic-related patients with a 100.00% patient satisfaction rate. A total of 304 environmental sampling sites were collected, all yielding negative results, with no nosocomial infections occurring. This article elaborates in detail on the specific measures of closed-loop management for nosocomial infection prevention and control.

Full Text

Abstract

During the Beijing 2022 Winter Olympic and Paralympic Games (hereinafter referred to as the Winter (Paralympic) Olympics), our hospital served as the designated oral medical institution, presenting a formidable challenge for nosocomial infection control when treating Olympic-related patients. Drawing upon infection prevention and control standards from emergency departments of specialized dental hospitals and integrating COVID-19 prevention and control protocols, we established dedicated isolation channels and independent consultation rooms for Olympic-related patients and medical staff. A total of medical staff members (divided into groups, with doctors and nurses in each group) entered the closed-loop system, working in batches with a training pass rate of %. Medical staff strictly adhered to personal protection protocols before, during, and after treatment, while treatment areas (including surfaces and reusable medical instruments) underwent rigorous disinfection. We admitted Olympic-related patients, achieving a patient satisfaction rate of %. Environmental sampling at sites yielded all negative results, with no nosocomial infections occurring. This article elaborates on the specific measures of closed-loop management for hospital infection prevention and control.

Keywords: dental treatment; hospital infection prevention and control; closed-cycle management; nursing management

Background

The Beijing 2022 Winter Olympic and Paralympic Games (hereinafter referred to as the Winter (Paralympic) Olympics) were successfully held in Beijing and Zhangjiakou. In accordance with the unified requirements of the Organizing Committee, all Olympic-related personnel were placed under closed-loop management during the Winter (Paralympic) Olympics. As the designated oral medical institution during this period, our hospital undertook the critical responsibility of providing oral treatment to Olympic-related personnel. Dental diagnosis and treatment possess unique characteristics: oral medical workers maintain close proximity to patients for extended periods during examinations and treatment, patients must remove their masks and keep their mouths open, and commonly used equipment such as high-speed turbine handpieces and ultrasonic scalers may generate splatter, droplets, and aerosols mixed with patient blood and saliva. These contaminants can travel considerable distances and disperse widely, creating high infection risks. Our hospital developed relevant diagnosis and treatment protocols by integrating COVID-19 prevention and control measures with the closed-loop management requirements for Olympic-related personnel, implementing strict closed-loop management to prevent cross-infection inside and outside the hospital. This article summarizes the oral emergency closed-loop management process during the Winter (Paralympic) Olympics to provide a reference for future clinical infection prevention and control.

1 Closed-Cycle Prevention and Control Strategies for Dental Emergency

1.1 Establishment of Dedicated Olympic Treatment Area

To address infection prevention and control during the Winter (Paralympic) Olympics, our hospital designated an independent Olympic treatment area using existing resources, comprising one consultation room (with two dental chairs) and one radiography room, along with a buffer zone for medical staff to change protective clothing. This area included contaminated, buffer, and clean zones, and was exclusively reserved for Olympic-related patients while being temporarily isolated from other areas. The treatment area was clearly marked to prevent regular patients from entering, with temporary barriers established to create dedicated passages for Olympic-related personnel and medical staff.

1.2 Medical Staff Protection Measures

Before Treatment: Medical staff practiced thorough hand hygiene and ensured skin integrity. They inspected medical protective equipment for integrity, seal performance, and comfort to ensure proper usage compliant with prevention and control requirements.

During Treatment: Except for necessary assisting nurses (preferably one), no other unrelated personnel entered the consultation room. Medical staff wore medical protective masks (N95), gloves, work caps, disposable protective suits, disposable isolation gowns, goggles/protective face shields, and shoe covers throughout the procedure. They performed hand hygiene before and after treatment according to protocol.

After Treatment: Upon exiting the consultation room, medical staff removed face shields and shoe covers, entered Buffer Zone 1 to remove goggles, then removed protective suits and boot covers. In Buffer Zone 2, they removed masks and caps before entering the clean area to change into new masks and caps, put on outer clothing, and proceeded to the closed-loop rest area. Meals were taken separately. Used protective equipment was immersed and disinfected with chlorine-containing disinfectant at mg/L concentration. When removing protective equipment, staff avoided touching contaminated surfaces, and disposable items were placed in medical waste bins as required.

1.3 Treatment Area Protection Measures

Contact Surface Areas: Easily contaminated and difficult-to-clean surfaces such as light handles, dental chair control buttons, three-way syringe handles, and saliva ejector handles were covered with disposable isolation films (covers), replaced after each treatment. When contaminated, surfaces were disinfected by wiping with chlorine-containing disinfectant at mg/L concentration.

Dental Chair Treatment Units: Non-contact surfaces including cabinets,

drawers, and computer keyboards received terminal disinfection using chlorine-containing disinfectant at mg/L concentration after each treatment.

Reusable Medical Instruments: Instruments were pre-disinfected on-site in the consultation room using chlorine-containing disinfectant at mg/L concentration for minutes, then transported in sealed containers to the sterilization supply center for processing according to dental instrument disinfection technical specifications.

Goggles/Protective Face Shields: After each treatment, these were immersed in chlorine-containing disinfectant at mg/L concentration for minutes, then cleaned, disinfected, dried, and stored in a clean area (or discarded after single use).

1.4 Treatment Facility Protection Measures

After receiving Winter (Paralympic) Olympic patients, nurses performed terminal disinfection of surfaces, air, and floors in the treatment area. Dental chair treatment units (including non-contact surfaces) were wiped with chlorine-containing disinfectant at mg/L concentration. Hydrogen peroxide air disinfection machines were activated with doors and windows closed, with operation time calculated based on room volume. For the radiography room, radiographic equipment was wiped with chlorine-containing disinfectant at mg/L concentration.

Cleaning staff disinfected isolated public areas, consultation room and restroom door handles, and contact surfaces with chlorine-containing disinfectant at mg/L concentration after Olympic patient visits. Floors in treatment units, radiology departments, and public areas were disinfected with chlorine-containing disinfectant at mg/L concentration.

1.5 Closed-Loop Management Strategy for Olympic Patient Reception

The closed-loop management workflow for receiving Olympic patients is illustrated in Figure 2.

Patient Arrival: Before Olympic patients arrived, the hospital director notified the emergency coordinator, who proceeded to the consultation room. The receiving doctor and nurse donned disposable protective suits, masks, face shields, gloves, and shoe covers via Entrance C in the clean area, passed through the buffer zone, and entered the Olympic consultation room (contaminated area) to prepare. The receiving doctor could complete registration procedures based on information provided by the emergency coordinator. The receiving nurse prepared routine treatment supplies in the Olympic consultation room, while the receiving doctor waited at Entrance B to receive the ambulance. The patient was transported by wheelchair via Entrance B into the Olympic consultation room (if necessary).

Pre-Examination and Treatment: Pre-examination temperature measurement was conducted using a thermometer. Olympic patients with negative nucleic acid test results within hours did not require retesting; those without results received nucleic acid sampling in the Olympic consultation room. The sample transport box was placed outside Entrance B, sprayed with disinfectant, and auxiliary nurses were notified to receive it from outside Entrance B. The receiving doctor conducted diagnosis and treatment, informed the emergency coordinator of the estimated treatment duration, and coordinated whether the ambulance driver should wait.

Radiography: If radiographs were required, the emergency coordinator notified the closed-loop radiology department doctor, who completed protection in the clean area before the patient entered the X-ray room.

Consultation and Surgery: If surgical or anesthesiology consultation was needed, the receiving doctor notified the emergency coordinator to request closed-loop surgeons and anesthesiologists. After protection completion in the clean area, they consulted via Entrance C. If necessary, the receiving nurse collected blood samples, placed tubes and lab requisitions in a transport box outside Entrance B, sprayed disinfectant, and notified auxiliary nurses to receive it. If surgery was required, the patient waited in the Olympic consultation room while test results were processed and closed-loop anesthesiologists prepared. The receiving doctor and nurse then transported the patient via wheelchair through Entrance B to the closed-loop operating room in the ward, following a designated route for handover with ward nurses. After surgery, the receiving doctor and nurse removed protective clothing and entered the closed-loop rest area.

Patient Transfer: If ambulance transfer was needed, the emergency coordinator notified the director to arrange it. The receiving doctor guided the patient via Entrance B onto the ambulance. After patient departure, the receiving doctor and nurse removed protective clothing in Buffer Zone 1, then removed masks and caps in Buffer Zone 2, put on outer clothing in the clean area, and exited via Entrance C to the closed-loop ward rest area. The nurse, wearing isolation gown, mask, face shield, and gloves, entered the isolation area hours later for environmental nucleic acid sampling after ventilation. The transport box was placed outside Entrance B for auxiliary nurses to receive. The nurse then removed isolation clothing in Buffer Zone 1 and proceeded to the rest area. Cleaning staff disinfected floors according to infection control requirements.

Positive Cases: If an Olympic patient tested positive for nucleic acid, they were immediately transferred to Ditan Hospital by ambulance. Nurses cleaned and disinfected the consultation room and passages, completing environmental nucleic acid sampling.

2 Material Supply Guarantee

Dedicated personnel and storage were assigned for the reserve and distribution of medical protective equipment, with meticulous management tracking daily

usage to prevent waste while ensuring timely supply of medical items.

3 Treatment Route Modification

Following closed-loop principles, treatment routes were modified as shown in Figure 1. Our hospital established a dedicated treatment area and passage for Olympic personnel, isolated from regular patient areas, with clear signage to prevent regular patients from entering. Connections between Entrance B and Entrances A and C were severed, with temporary barriers creating dedicated channels for Olympic-related personnel and medical staff. Regular patients and medical staff used Entrance A, separating routes to avoid cross-infection and ensure full closed-loop management.

4 Medical Staff Training and Drills

All emergency medical staff systematically studied COVID-19 knowledge through standardized training programs.

Protection Training: Covered medical staff protection measures, disinfection technical specifications, and medical waste disposal protocols. One-on-one training via video and on-site instruction ensured proficiency in donning and doffing protective clothing, wearing masks, goggles, and face shields.

Process Training: Following the hospital and department's full closed-loop management protocols, medical staff participated in repeated simulation drills and process walkthroughs.

Etiquette Service Training: Completed Winter Paralympic knowledge training provided by the Organizing Committee and passed online assessments. After passing, medical staff were selected to handle Olympic patient reception, with repeated drills on the full closed-loop management process to ensure mastery of reception procedures.

Testing: Medical staff underwent weekly COVID-19 nucleic acid throat swab testing, with comprehensive monitoring ensuring full infection prevention and control.

5 Strengthening Department Personnel Management and Psychological Support

Hospital COVID-19 prevention and control requirements were strictly implemented. While maintaining outpatient workload, designated personnel were assigned to implement the "daily reporting, zero omission reporting" system. Psychological support was strengthened for staff and their families through WeChat work groups, with strict prohibitions against spreading misinformation to prevent panic. During the Winter (Paralympic) Olympics, medical staff's psychological well-being and work status were monitored in real-time, with counseling provided for those with unstable emotions. Video chats between family members

and patients were arranged to effectively alleviate emotional distress. Medical staff received COVID-19-related knowledge training through online and offline channels. Since gathering for training was impossible, psychological knowledge was distributed via WeChat for short-term learning of relaxation techniques.

6 Prevention and Control Effects

During the Winter (Paralympic) Olympics, medical staff training achieved a pass rate of %. A total of patients were treated, including emergency cases (acute pulpitis, pericoronitis, etc.) and non-emergency cases, with a patient satisfaction rate of %. The average duration for diagnosis, treatment, and terminal disinfection was hours per case. After disinfection, nucleic acid sampling was performed on patient contact surfaces, with samples collected from sites, all yielding negative results. Closed-loop management involved groups of medical staff (doctors and nurses per group), working in batches with daily health monitoring and nucleic acid testing, all negative, with no nosocomial infections occurring during the reception process.

7 Summary

During the Winter (Paralympic) Olympics, the number of overseas personnel entering Beijing was substantial and widespread. Our emergency department implemented a full closed-loop management model for Olympic personnel, establishing independent Olympic consultation rooms and dedicated medical staff (groups, with doctors and nurses per group) working in shifts. Both patients and medical staff were under closed-loop management with independent consultation rooms and isolation channels, minimizing cross-flow of personnel and achieving zero nosocomial infections. Based on national prevention and control guidelines and emergency department realities, we refined prevention and control systems, processes, and emergency plans through repeated drills, achieving % medical staff training compliance. During the Winter (Paralympic) Olympics, Olympic-related patients were treated. Through comprehensive video monitoring and real-time intercom guidance, we standardized medical staff behaviors during donning/doffing protective clothing, treatment, and environmental disinfection to prevent occupational exposure and establish effective protective barriers. Video consultation ensured medical quality, achieving % patient satisfaction. Through both external process modifications and enhanced internal protection awareness among medical staff, we ensured high-quality medical care and zero nosocomial infections during the Winter (Paralympic) Olympics.

Conflict of Interest Statement: The authors declare no conflicts of interest.

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Note: Figure translations are in progress. See original paper for figures.