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Perspective article

Specific actions of Taiwan's dental community for the one health issue

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One Health is a comprehensive and unified approach to balance and optimize the health of people, animals, and the environment. It is particularly important for preventing, predicting, detecting, and responding to global health threats such as the COVID-19 pandemic. This approach mobilizes multiple sectors, disciplines, and communities at different levels of society to work together. In this way, new and better ideas can be developed to address root causes and create long-term, sustainable solutions.¹ Climate change and emerging infectious diseases caused by human factors not only pose a threat to humans, food

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Table 1 The important events of global public health and One Health, and the specific actions of Taiwan's dental community for One Health issue.

Year	The important events of global public health and One Health, and the specific actions of Taiwan's dental community for One Health issue
A. The important events of global public health and One Health	
2002	Between November 2002 and September 2003, the epidemic of the severe acute respiratory syndrome (SARS) occurred in 29 countries and regions. Taiwan was also one of the countries hit by SARS.
2004	The Wildlife Conservation Society brought together a group of human and animal health experts for a symposium at Rockefeller University in New York City in 2004. The symposium set 12 priorities to combat health threats to human and animal health. These priorities, known as the "Manhattan Principles", called for an international, interdisciplinary approach to prevent disease and formed the basis of the "One Health, One World" concept.
2007	The International Ministerial Conference on Avian and Pandemic Influenza was held in New Delhi India 2007. The governments were encouraged to further develop the One Health concept by building linkages between human and animal health systems for pandemic preparedness and human security.
2008	The Food and Agriculture organization (FAO), World Organization for Animal Health (WOAH), World Health Organization (WHO), United Nations International Children's Emergency Fund (UNICEF), the World Bank, and the United Nations System Influenza Coordination (UNSCIC) came together to develop a document titled "Contributing to the "One Health, One World"- A Strategic Framework for Reducing Risks of Infectious Diseases at the Animal-Human-Ecosystems Interface.
2009	The United States Agency for International Development (USAID) launched the Emerging Pandemic Threats Program to ensure a coordinated, comprehensive international effort to prevent the emergence of diseases of animal origin that could threaten human health.
2010	The 2010 International Ministerial Conference on Avian and Pandemic Influenza was held in Hanoi, Vietnam. At the conclusion of the meeting, participants unanimously adopted the "Hanoi Declaration", which called for focused action at the animal-human-ecosystem interface and recommended broad implementation of One Health.
2011	The first International One Health Congress was held in Melbourne, Australia in 2011. In addition to understanding the interdependence of human, animal, and environmental health, attendees agreed that it is important to include other disciplines such as economics, social behavior, and food safety and security.
2012	The first One Health Summit was held in Davos, Switzerland in 2012. The Summit presented the One Health concept as a way to manage health threats, focusing on food safety and security.
2012	The Middle East respiratory syndrome coronavirus (MERS-CoV) was first reported from a pneumonia patient in Saudi Arabia in 2012. Until 2015, MERS-CoV cases have occurred in 25 countries around the world.
2019	The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) disease was first reported in China at the end of 2019. Subsequently, COVID-19 cases were reported in many countries around the world in early 2020, gradually turning into a global pandemic.
B. The specific actions of Taiwan's dental community for the One Health issue	
2003	Taiwan was one of the countries affected by the SARS outbreak. The Taiwan government, medical system and people gained experience in dealing with this highly contagious disease during the outbreak. As for oral medical workers who face high risks, Taiwan's dental community has formulated various SARS prevention measures for oral medical workers.
2004	Under the total budget system of National Health Insurance (NHI), the Taiwan government began to plan the "Implementation Plan for Strengthening Infection Control in Dental Outpatient Clinics" and formulate the "Standard Operating Procedures (SOP) for Infection Control in Dental Institutions".
2005	The Taiwan NHI has begun to implement the "Implementation Plan for Strengthening Infection Control in Dental Outpatient Clinics" in 2005. Under the total budget system of NHI, dental institutions conduct self-inspections to confirm that the infection control hardware and software (equipment and operating procedures) meet the standards and declare independently. The NHI gives dental institutions 30 NHI points per patient's dental visit to cover the dental infection control cost. This measure was first implemented on a trial basis in July 2004. This may be the first system in the world for subsidizing the dental infection control cost to dental institutions through an independent management mechanism under the insurance system.
2007	Taiwan implemented a continuing education system for dentists in 2003, and this system added a requirement in 2007 that continuing education courses should include courses of infection control.
2013	The requirements for the "Implementation Plan for Strengthening Infection Control in Dental Outpatient Clinics" were increased by referring to the standards of the US Centers for Disease Control and Prevention (CDC).
2013	The dental infection control cost of NHI increased to 40 NHI points per patient's dental visit.
2015	After more than a year of research, the Taiwan Centers for Disease Control (CDC) released the first official version of the "Guidelines on Dental Infection Control Measures" in 2015.

(continued on next page)

Table 1 (continued)

Year	The important events of global public health and One Health, and the specific actions of Taiwan's dental community for One Health issue
2015	Starting from 2015, medical institutions that fail to implement the "Implementation Plan for Strengthening Infection Control in Dental Outpatient Clinics" and fail to report monthly dental outpatient consultation fees that comply with this plan for infection control will not be issued quality assurance retention funds (annual additional bonus).
2015	The dental infection control cost of NHI increased to 55 NHI points per patient's dental visit.
2016	Based on the "Guidelines on Dental Infection Control Measures", a new version of the "Implementation Plan for Strengthening Infection Control in Dental Outpatient Clinics" was revised and designed. At this time, dental infection control in Taiwan has officially entered a new era and stage under the official guidelines.
2016	The dental infection control cost of NHI increased to 83 NHI points per patient's dental visit.
2018	Due to the medical service cost index growth and budget adjustment of NHI system, the dental infection control cost of NHI increased to 90 NHI points per patient's dental visit.
2020	The Taiwan's dental community adopted contingency measures in response to the COVID-19 pandemic as follow. 1) Dentists strengthen inquiries about the patient's detailed systemic medical history, infectious disease history, and TOCC (Travel, Occupation, Contact, and Cluster) before dental treatment. 2) Dentists, nursing staff, and dental assistants need to wear personal protective equipment, including at least masks, gloves, and clean overalls, as well as wear isolation gowns, hair caps, masks or goggles as needed. 3) According to the situation, dentists adjust the process and reduce dental splash and aerosol during dental treatment (such as the use of air-water syringes, ultrasonic scalers, or high-speed tooth grinding handpieces). 4) When community infection breaks out, non-urgent dental treatment will be postponed.
2020	The Taiwan CDC formulated "Guidelines on Dental Infection Control Measures in response to the COVID-19" in 2020.
2020	In conjunction with the comprehensive improvement of the quality of dental infection control, the dental infection control cost of NHI increased to 125 NHI points per patient's dental visit.
2021	At the peak of the COVID-19 pandemic in 2021, more than 10 million people received dental services with nearly 40 million visits, and no one contracted the disease due to dental treatment procedures. The Taiwan's dental community continued to implement infection control to respond to various emerging infectious diseases and to ensure the safety of people seeking for dental treatment.
2023	The dental infection control cost of NHI increased to 132 NHI points per patient's dental visit.

supplies and economies, but also pose a threat to various species. The three highly pathogenic and lethal human coronaviruses (HCoVs), severe acute respiratory syndrome coronavirus (SARS-CoV), Middle East respiratory syndrome coronavirus (MERS-CoV), and SARS-CoV-2 (the pathogen of COVID-19), have appeared one after another in the latest 20 years. However, these viruses have caused three global outbreaks in this period and are likely to have had an evolutionary origin from bats.² Therefore, in the future world, One Health is an important global movement to involve the public health, veterinary, and environmental sectors. The One Health approach has important implications for food and water security, nutrition, the control of zoonoses (diseases that can be transmitted between animals and humans, such as influenza), pollution management, and combatting antimicrobial resistance.¹ The purpose of One Health is to promote collaboration among professionals from different disciplines locally, nationally, and globally to achieve optimal health for humans, animals, and our environment.³

In fact, dentistry is also an important part of the One Health issue. One Health is closely related to the environment. The daily dental practice is also closely related to

the environment, including clinic air quality, waste disposal, biofilms, and asepsis. Additionally, dental practices are linked to the global environment by means of mercury disposal, infectious diseases, fluoride application, and air and water quality.⁴ In our dental practices, we are interdependent with our surroundings. We practice infection control to minimize and prevent the spread of diseases in our daily practices. We maintain good hygiene to prevent the contamination in our clinics and homes. We rely on the community for both water supply and clinic waste disposal. These must be interdependent with our community environment. This interdependence is the essence of One Health. Therefore, the dentistry is also part of One Health.⁴

Between November 2002 and September 2003, the epidemic of the severe acute respiratory syndrome (SARS) occurred in 29 countries and regions. Taiwan was also one of the countries hit by SARS. We gained experience in dealing with this highly contagious disease during the outbreak. As for oral medical workers especially dentists who face high risks, Taiwan's dental community has formulated various SARS prevention measures for oral medical workers. Since 2003, a series of dental infection control strategies have been implemented in Taiwan and

have been effective during the COVID-19 outbreak. In fact, these actions are also essential for the One Health approach. In this article, we used information from the US Centers for Disease Control and Prevention (CDC) website,⁵ searched for publicly available information released by the Taiwan Dental Association (TWDA) and reviewed our previous clinical experience to sort out the important events of global public health and One Health, and the specific actions of Taiwan's dental community for the One Health issue. The results are shown in Table 1. Since the Wildlife Conservation Society set the "Manhattan Principles" to form the basis of the "One Health, One World" concept for the first time in 2004, the One Health concept has gradually gained more recognition in the public health and animal health communities. From 2002 to 2019, the three highly contagious and lethal HCoVs, called SARS-CoV, MERS-CoV, and SARS-CoV-2 (the pathogen of COVID-19), have caused three global outbreaks, respectively. However, they are likely to have had an evolutionary origin from bats.² The diseases caused by them are so-called zoonoses, while the control of zoonoses is one of the important issues in the One Health approach. Furthermore, after the outbreak of SARS in Taiwan in 2003, the Taiwan government began to plan the dental infection control strategies under the NHI system. Then, a series of measures for dental infection control were implemented, such as giving qualifying dental institutions an additional cost for the dental infection control under the NHI system and requiring infection control courses as compulsory courses in the continuing education system for dentists. The dental infection control cost per patient's dental visit increased from 30 NHI points in 2005 to 132 NHI points in 2023. During this period, there were a total of 6 times for increasing the dental infection control cost per patient's dental visit, and the increase rate was as high as 317 %. It should be noted that the value of one NHI point is settled quarterly, and one NHI point fluctuates around NT\$ 0.8–1.2. To the best of our knowledge, this may be the first system in the world for subsidizing the dental infection control cost to dental institutions through an independent management mechanism under the insurance system. In addition, relevant dental infection control regulations have been continuously revised and refined. In 2015, the Taiwan Centers for Disease Control (CDC) released the "Guidelines on Dental Infection Control Measures", which was the first official regulation for dental infection control. Based on these experiences in performing dental infection control, the Taiwan's dental community adopted contingency measures in response to the COVID-19 pandemic. Our dental services have never been interrupted during the COVID-19 pandemic. At the peak of the COVID-19 pandemic in 2021, more than 10 million people received dental services with nearly 40 million visits, and no one contracted the disease due to the dental treatment procedures. The Taiwan's dental community continued to implement infection control to respond to various emerging infectious diseases and to ensure the safety of people seeking for dental treatments.

Although our government has not connected dental infection control with the One Health issue, these series of specific actions on dental infection control in Taiwan are indeed part of the One Health approach. The specific effect of its practice is to reduce the risk of disease transmission

during the dental treatment procedures, thereby promoting the oral health and the overall health of the people, and also exerting the effect of the control of zoonoses to a certain extent. In addition to the infection control issue, however, the principles of One Health concept linked to relevant important issues require our deep reflection, for example, the following questions:

1. How does processing large amounts of the dental waste from infection control and pathogen screening affect the environment?
2. Does the dental wastewater containing disinfectant and cleaning agents cause environmental pollution and environmental hormone problems after being discharged into the environment?
3. Does the dust generated by dental laboratory operations affect human health and air quality and cause environmental pollution problems?
4. Do high-efficiency disinfection and air filtration equipment with high energy consumption indirectly cause energy consumption and carbon emission problems?
5. Do the practice of dental infection control and the usage of dental antibiotics potentially contribute to the generation of resistant microbial strains?
6. Are dental practitioners concerned about the above issues beyond their practice?

The rise of novel viruses or the changes in the epidemiology of known viruses with zoonotic origin is a concern for all health care personnel. The ongoing COVID-19 pandemic demonstrates how devastating zoonotic viral infections can affect human health and why oral health personnel should adopt the One Health approach. Given the ability of the oral cavity to support pathogenic virus and its connections to other parts of the body, dental staff will continue to be exposed to new, emerging, and relapsing zoonotic diseases in the future. The COVID-19 has reinforced why oral health is an integral part of the overall health and why oral care is essential for the overall health.⁶ Clearly, the issues of One Health are closely related to dental practices. Being prepared is crucial, whether it is about the potential emergence of new diseases in dental settings, challenges related to sanitation and access to clean water, or any other environmental hazard.⁴

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

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