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The Impact of COVID-19 on Dentistry in Yichang, China, and Protective Suggestions for Normalisation of Epidemic Prevention



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ABSTRACT

Background: Coronavirus disease 2019 (COVID-19) has been identified as a pandemic by the World Health Organization in March 2020, and it affects all aspects of life, including dental care.

Objectives: The purpose of this article is to explore the impact of COVID-19 on the daily operations of the stomatology department and provide some guidance for dental health care personnel around the world in continuing to provide exemplary care while limiting the spread of COVID-19.

Materials and methods: Retrospective analyses were performed on dental patients' medical records from the stomatology department of the First People's Hospital of Yichang, China, which were collected in the pre-epidemic, epidemic, and post-epidemic periods. Hospital-wide triage and stomatology department-specific protocols were established in the hospital to prevent cross-infection during the COVID-19 pandemic.

Results: The number of patients decreased and proportion of emergency cases increased during the epidemic period. With prevention protocols in place, the number of dental patients returned to the normal range with a slight elevation during the post-epidemic period. Thus far, there has not been a single documented case of COVID-19 related to dental treatment in the hospital.

Conclusions: COVID-19 has a major impact on daily life, including dental care services. Effective prevention and control measures including 3 levels of protection—zoning, instrumentation, and environmental disinfection—are needed for dental settings to provide care.

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Introduction

Since the first reports from China in December of 2019, coronavirus disease 2019 (COVID-19) has altered daily life in ways not seen since the Spanish flu of the early 20th century.^{1,2} Globally, as of 4 February 2021, there have been 103,631,793 confirmed cases of COVID-19, including 2,251,613 deaths.³ While new cases in China are now sporadic, hundreds of thousands of new cases are still being reported around the globe. Hospitals and medical practices must now concentrate on treating patients with COVID-19, and preventing hospital-

acquired infections while maintaining a high standard of care for all.⁴ For departments like stomatology, where cross-infection already is a regular concern, preventing patients and clinical workers from COVID-19 infection requires detailed risk assessment and planning.⁵

In a relatively closed clinical environment, prolonged exposure to high concentrations of aerosolised virus could lead to COVID-19 transmission between patients and staff.⁶ During dental procedures, high-speed dental handpieces, ultrasonic dental scalers, and other specialised instruments produce a large amount of airborne droplets which may persist for some time.⁷ Droplets and aerosols may contain microorganisms, posing potential threats to the health of patients and clinical workers.⁸ Therefore, specialised protocols must be developed to prevent cross-infections between dental health care personnel (DHCP) and patients.⁹ The People's First

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Hospital of Yichang has adopted effective measures since the beginning of the COVID-19 outbreak, and no case of cross-infection due to oral operations has been documented so far.

From January to April 2020, China enacted strict prevention and control measures to contain the spread of COVID-19. From April to late June 2020, city-wide hospital reopening saw patient numbers begin to rise again to nearly pre-epidemic levels. Increased public awareness and public health measures meant that patients returning to the clinic were already prepared for altered protocols. In late June 2020, based on existing protocols, the hospital officially proposed a policy for normalizing epidemic prevention as China prepared to enter the post-COVID-19 era. In this study, dental patients' visiting patterns before, during, and after the peak of the outbreak were compared, and prevention protocols are shared. Providing successful experiences contributes to the process of normalizing epidemic prevention in dentistry.

Methods

Retrospective study

On 10 January 2020, the Chinese government announced prevention and control measures against COVID-19 which were phased out in April 2020. Since then, people have returned to their daily activities, including regular visits to the stomatology department, along with the new daily routines of mask wearing and social distancing. To assess and compare patient visiting patterns through the epidemic, departmental medical records were collected to examine patient flux in the pre-epidemic period, epidemic period, and post-epidemic period.

Each period examined included medical records from a 3-month span. The pre-epidemic period included records from 10/10/2019 to 01/10/2020, the epidemic period included records from 01/11/2020 to 04/11/2020 with a reference period from 01/11/2019 to 04/11/2019, and the post-epidemic period included records from 04/12/2020 to 07/11/2020 with a reference period from 04/12/2019 to 07/12/2019. The pre-epidemic period indicates patient habits before control measures were initiated, the epidemic period includes the duration of government-ordered restrictions, and the post-epidemic period describes patient behaviour following the removal of government-enforced restrictions. All records used in this study were stripped of any personally identifiable information and contained only age, sex, diagnosis, and treatment.

Statistical analysis

An independent t test was used to compare the means in the continuous variable (patient age), and a Chi-square test was used to compare ratios in qualitative variables (sex and disease type). The continuous variable (age) was described by mean and standard deviation, and normality was assumed through the central limit theorem since the smallest group had more than 500 samples. The qualitative variables (gender and disease type) were described by frequency and percentage. SPSS19.0 (IBM Corp.) was used for statistical analysis; $P < .05$ was considered statistically significant.

Results

As shown in Tables 1 through 3, various analyses were carried out comparing these time periods. Table 1 shows that pre-epidemic, the number of patients was significantly greater than during the epidemic, while the age was significantly lower. There was no obvious difference between acute and non-acute cases during the pre-epidemic, while acute cases were obviously greater than non-emergency cases during the epidemic. Table 2 shows that in the post-epidemic period, patient age was significantly lower, and distribution of disease type was significantly different than those in the epidemic period. There was also no significant difference in sex between these two periods. Table 3 shows that, compared to its 2019 reference period, there were significant differences in all categories for the post-epidemic period. In this period, age was significantly lower, and there were significant differences in sex and disease distributions. Table 4 shows a summary for all treatment types in all five time periods. The data are presented as frequencies and percentages.

Discussion

Several scenarios could explain the change in patient composition. During the epidemic period, with the COVID-19 control measures in place, people were either unable or unwilling to leave their residences. Most patients tried to manage pain and only visited the department when complications had progressed to an acute phase. Comparing generations, young people generally had more access to information related to COVID-19 through the internet, which made them more afraid of being infected.^{10,11} Therefore, the average patient age was older during the epidemic (Table 1). Additionally, when patients came to the stomatology department, they

Table 1 – Comparison of patient characteristics for the pre-epidemic and epidemic periods.

Time period	Case	Age	Sex		Disease	
			Male	Female	Acute	Non-acute
Pre-epidemic (10/10/2019–01/10/2020)	4723	38.57 ± 13.71	2278	2445	2561	2162
Epidemic (01/11/2020–04/11/2020)	569	40.12 ± 14.58	271	298	473	96
		$P = .011$	$P = .785$		$P < .001$	

Table 2 – Comparison of patient characteristics for the epidemic and post-epidemic periods.

Time period	Case	Age	Sex		Disease	
			Male	Female	Acute	Non-acute
Epidemic (01/11/2020–04/11/2020)	569	40.12 ± 14.58	271	298	473	96
Post-epidemic (04/12/2020–07/11/2020)	4876	37.54 ± 10.45	2311	2565	2021	2855
		<i>P</i> < .001	<i>P</i> = .917		<i>P</i> < .001	

Table 3 – Comparison of patient characteristics for the post-epidemic period and the same period in the prior year.

Time period	Case	Age	Sex		Disease	
			Male	Female	Acute	Non-acute
2019 Reference (04/12/2019–07/11/2019)	4237	40.27 ± 13.64	2174	2063	2131	2106
Post-epidemic (04/12/2020–07/11/2020)	4876	37.54 ± 10.45	2311	2565	2021	2855
		<i>P</i> < .001	<i>P</i> < .001		<i>P</i> < .001	

Table 4 – The comparison of treatment types and numbers for the pre-epidemic, epidemic, and post-epidemic periods.

Time period*	Case	RCT	Extraction	Debridement	Medication	Rehabilitation	Orthodontics	Periodontal
Pre-epidemic	4723	1194 (25.28%)	978 (20.71%)	323 (6.84%)	297 (6.29%)	1039 (21.99%)	579 (12.26%)	313 (6.63%)
2019 Reference-1	4336	1064 (24.54%)	865 (19.95%)	301 (6.94%)	271 (6.25%)	1055 (24.33%)	487 (11.23%)	293 (6.76%)
Epidemic	569	209 (36.73%)	65 (11.42%)	79 (13.89%)	216 (37.96%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
2019 Reference-2	4237	1067 (25.18%)	879 (20.75%)	312 (7.36%)	206 (4.86%)	1037 (24.47%)	603 (14.23%)	133 (3.15%)
Post-epidemic	4876	1232 (25.27%)	913 (18.73%)	403 (8.26%)	233 (4.78%)	1178 (24.16%)	637 (13.06%)	280 (5.74%)

* Pre-epidemic: 10/10/2019 to 01/10/2020. 2019 Reference-1: 01/11/2019 to 04/11/2019. Epidemic: 01/11/2020 to 04/11/2020. 2019 Reference-2: 04/12/2019 to 07/11/2019. Post-epidemic: 04/12/2020 to 07/11/2020. RCT, root canal therapy.

might not have received the usual treatments. In order to avoid cross-infections, no treatments involving splatter were performed (Table 4). For instance, for patients with acute pulpitis, only oral antibiotics were given in place of the usual endodontic therapies. Thus, these patients might come back during the post-epidemic period to seek more treatment, which could explain the increase in the number of cases (Tables 2 and 3).

During the post-epidemic period, increased public awareness of COVID-19 prevention measures and defined hospital control protocols encouraged people to seek dental care in large hospital stomatology departments instead of in smaller clinics. The real or perceived increase in personal safety associated with well-established hospitals may be another factor driving the increased number of patients in the post-epidemic period (Tables 2 and 3). In addition, acute cases were either treated or temporarily controlled by medications, such that when these patients revisit the department, their conditions would be non-acute. This potentially explains the higher proportion of chronic/non-acute cases during the post-epidemic period when compared to the epidemic period (Table 2).

The statistical results showed that during the COVID-19 outbreak, the number of patients visiting the stomatology department decreased drastically. Since the hospital's full reopening in April 2020, the number of dental patients started to rise again steadily. In the past 3 months, prevention protocols, including hospital-wide triage and stomatology departmental protocols, were enacted and enforced to maximise the safety of DHCP and dental patients.

As for the stomatology department, cross-infections were effectively contained by strictly adhering to all specified protocols. These included mandatory levels of protection, proper zoning, appropriate instrument usage, and frequent environmental disinfection. All dental patients were required to go through two sets of triage, where patients' temperature as well as medical and epidemic histories are taken. Only patients with no signs or symptoms and a history clear of COVID-19 could receive treatment. There has been no reported COVID-19 infections due to dental procedures in our department.

Other hospitals and their stomatology departments in the area all have their own prevention protocols; some are similar to what is described here, whereas others are different. Currently, many other hospitals either only treat



Fig. 1 – The dentist is performing an open operation.

emergency dental patients or only treat patients who already received negative COVID-19 test results. Excluding non-critical patients would delay those who need regular treatment. Requiring COVID-19 test results effectively ensures the safety of DHCP and patients but adds unnecessary financial burden and prolongs patient waiting times. In contrast, the hospital assesses risks through big data, such as the use of health QR codes on smartphones. The health QR code, based on exact data, is submitted online by residents or others. After the background review, a coloured health QR code will be granted, which is used as an electronic device for individuals to pass in and out of the local area. The generation of the health QR code consists of basic personal information, including face recognition, and wide public information coming from public security, mobile operators, health commission, high-speed rail, airports, and highway crossings, which have been technologically integrated and analyzed in big data. The colours of the health QR code are red, yellow, and green. Red refers to the people whose medical management measures have not been lifted or have not been discharged after being diagnosed or those who are suspected of not being excluded, who are recommended for isolation.. Yellow indicates an individual that came from

high-risk area and entered the new locale for fewer than 14 days, and medical observation is recommended. Green indicates people who have no abnormalities or people whose medical management measures have been lifted, which means they can pass. When the code is green, proper care would be provided for this patient.¹²

In late June 2020, after Yichang had successfully maintained its low-risk status for 2 months and country-wide control measures were mostly lifted, the country was getting ready to enter the post-epidemic era. Now the normalisation of epidemic prevention was more important than ever. To accommodate the new normalisation, the hospital needed to enforce, monitor, and adjust its current prevention protocols to adapt to ever-changing situations. Current stomatology departmental protocols should be kept and strictly followed, and the use of big data and appointment systems should be improved. Patients should be encouraged to have COVID-19 tests when possible. In addition, the level of protection could be relaxed after careful risk assessments to prevent wasting protective equipment.

Even as the risk of COVID-19 infection in China continues to drop, precautions are likely necessary to exist for the foreseeable future. Incorporating epidemic prevention into daily life seems to be a long-term trend. Under such circumstances, DHCP, along with all other health care workers, should not only normalise preventive measures but also do so psychologically to avoid excessive medical treatments or unnecessary panic. On top of individual safety, public education should also be heightened to help patients maintain oral hygiene and dental health.

Prevention protocols

Hospital-wide triage and stomatology department-specific protocols are the two major axes of prevention executed at the hospital. The former ensures each patient will receive proper treatment, whereas the latter ensures the safety of DHCP and dental patients. Thus far, there has not been a single documented case of COVID-19 related to dental treatment reported in the hospital. Therefore, there is full confidence in the effectiveness of the current prevention protocols. Again, although the following protocols may not be applicable for all institutions, the rationale and strategic planning behind these protocols are universally adaptable and worth sharing with colleagues worldwide.

Table 5 – Three levels of protection.

Work area	Staff	Protection level*	Protection standard
Office and lounge	All staff	I	Work clothes, medical round cap, medical mask
Pre-inspection and registration	Nurses	II	Work clothes, medical round cap, surgical mask, goggles, N95 respirator, medical examination gloves
Admission and triage	Doctors or nurses		
General treatment	Doctors and nurses		
Splatter treatment	Doctors and nurses	III	Work clothes, medical round cap, face shield, goggles, N95 respirator, gown, protective clothing, medical sterilised gloves, shoe covers
Equipment cleaning	Nurses and technicians	II	Work clothes, medical round cap, surgical mask, goggles, waterproof apron, nitrile protective gloves, waterproof boots
Medical waste	Technicians		

* Primary protection, secondary protection, and tertiary protection are indicated by I, II, and III, respectively.



Fig. 2—Dental aerosol suction units.

In terms of hospital-wide triage, details of the screening process are displayed in [Figure 1](#). As for the stomatology departmental protocols, 4 different aspects—3 levels of

protection, zoning, instrumentation, and environmental disinfection—are emphasised.

As shown in [Table 5](#), 3 levels of protection are the foremost critical component of the departmental protocol. All personal protective equipment worn by DHCP are disposable. Replacement of personal protective equipment is required at least once every 4 hours or when they are wet or contaminated, whichever comes first.

For zoning purposes, clean, buffer, and contaminated zones are established in the stomatology department. Patient waiting areas and DHCP offices are designated as clean zones, whereas the treatment area is zoned as contaminated. Between the clean and contaminated zones, buffer spaces are placed to keep the two areas as far apart as possible. Besides regular treatment areas, there is also an independent, ventilated, and isolated clinic room set up to treat patients with suspected COVID-19 and those with fevers, where treatments are only provided if absolutely necessary.

New instruments were purchased and improvements on current instruments were made. To reduce aerosols created by treatment involving splatter, dental aerosol suction units were introduced ([Figure 2](#)). To enhance treatment, specially designed anti-retraction valves and rubber barriers were added to high-speed dental handpieces. Additionally, panoramic x-rays and cone-beam computed tomography are used whenever possible since intraoral x-ray examination could stimulate salivation and cough.^{7,13}

Like other neocrown viruses, 2019-nCoV can be effectively inactivated by heat at 56 °C or higher for 30 minutes, ethyl ether, 75% ethanol, chlorine-containing disinfectant, chloroform, and other lipid solvents, but it is not sensitive to chlorhexidine.¹⁴⁻¹⁶ Such characteristics are crucial in building the environmental disinfection protocol.

Different concentrations of a chlorine-containing disinfectant are used for disinfection. For regular daily disinfection, 500 mg/L of designated disinfectant is used to clean various surfaces. For the purpose of decontamination, higher concentrations (500–1000 mg/L) of the disinfectant are used. All dental instruments are disinfected with 75% ethanol. Then, those that can withstand pressure steam sterilisation are soaked for 30 minutes with a chlorine-containing disinfectant (1000 mg/L) to prepare for steam sterilisation.

Conclusions

By comparing patient patterns among pre-epidemic, epidemic, and post-epidemic periods in the First People's Hospital of Yichang, it is clear that COVID-19 has changed people's habits regarding health care services, especially for the stomatology department. To protect DHCP and dental patients while providing dental care to the best of the department's ability, enforced prevention protocols have been established. Including hospital-wide triage and stomatology departmental protocols, the preventive measures discussed have successfully protected the entire department and the patients from cross-infection. As the country moves into normalisation of epidemic prevention, the hospital and department will keep enforcing, monitoring, and modifying prevention protocols to best fit both short-term and

long-term needs. Considering that the COVID-19 outbreak is likely to persist globally for the foreseeable future, it is hoped that the rather successful experiences shared in this study would help colleagues around the world to work more safely and provide better services for patients.

Authors' contributions

Suli Zhao conceived and designed the structure of this paper; Suli Zhao and Rongcan Sun wrote the paper; Jing Cao and Huaizhou Yu collected and sorted out the data; and Lin Zhang counted the results and reviewed the paper. All authors have read and approved the final manuscript.

Conflict of Interest

None disclosed.

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Ethics approval

This study was reviewed and approved by the Ethics Committee of the First People's Hospital of Yichang.

REFERENCES

1. Zhou P, Yang X, Wang X, et al. A pneumonia outbreak associated with a new coronavirus of probable bat origin. *Nature* 2020;579:270-3 7798.
2. Petropoulos F, Makridakis S. Forecasting the novel coronavirus COVID-19. *PLoS ONE* 2020. doi: 10.1371/journal.pone.0231236.
3. World Health Organization. WHO coronavirus disease (COVID-19) dashboard. Available from: <https://covid19.who.int/>. Accessed 4 February 2021.
4. Gugnani N, Gugnani S. Safety protocols for dental practices in the COVID-19 era. *Evid Based Dent* 2020;21:56-7 2).
5. Ather A, Patel B, Ruparel NB, et al. Coronavirus disease 19 (COVID-19): implications for clinical dental care. *J Endod* 2020;46:584-95 5).
6. Meng L, Hua F, Bian Z. Coronavirus disease 2019 (COVID-19): emerging and future challenges for dental and oral medicine. *J Dent Res* 2020;99(5):481-7. doi: 10.1177/0022034520914246.
7. Peng X, Xu X, Li Y, et al. Transmission routes of 2019-nCoV and controls in dental practice. *Int J Oral Sci* 2020;12(1):9. doi: 10.1038/s41368-020-0075-9.
8. Ali K, Raja M. Coronavirus disease 2019 (COVID-19): challenges and management of aerosol-generating procedures in dentistry. *Evid Based Dent* 2020;21:44-5 2).
9. Noh K, Loke J, Kim K. Could we have prevented all this? A comparison of the British and South Korean primary dental care response to COVID-19. *Br Dent J* 2020;228(12):916-8.
10. Cao W, Fang Z, Hou G, et al. The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry Res* 2020;287:112934. doi: 10.1016/j.psychres.2020.112934.
11. Gao J, Zheng P, Jia Y, et al. Mental health problems and social media exposure during COVID-19 outbreak. *PLoS ONE* 2020;15(4):e0231924. doi: 10.1371/journal.pone.0231924.
12. Li C, Tan C, Wu A, et al. COVID-19: the role of community in China's response. *JRSM* 2020;113:280-1 7).
13. İlhan B, Bayrakdar İS, Orhan K. Dental radiographic procedures during COVID-19 outbreak and normalization period: recommendations on infection control. *Oral Radiol* 2020;36(4):395-9. doi: 10.1007/s11282-020-00460-z.
14. Smith N, Fraser M. Straining the system: novel coronavirus (COVID-19) and preparedness for concomitant disasters. *Am J Public Health* 2020;110:648-9.
15. Gu J, Han B, Wang J. COVID-19: gastrointestinal manifestations and potential fecal-oral transmission. *Gastroenterology* 2020;158:1518-9.
16. Kampf G, Todt D, Pfaender S, et al. Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents. *J Hosp Infect* 2020;104(3):246-51.