

Dental unit waterline infection control practice and knowledge gaps

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ADA American Dental Association



Supplemental material is available online.

ABSTRACT

Background. Dental unit waterline (DWL) infection control is critical to infection prevention. Identifying challenges and barriers to its implementation is a first step toward understanding how to improve engagement.

Methods. A survey was distributed to dentists, dental hygienists, and dental assistants via the Qualtrics XM platform (Qualtrics). Responses were analyzed to quantify engagement in practices contrary to Centers for Disease Control and Prevention guidance and identify avenues to improve engagement.

Results. Although oral health care providers recognized DWL infection control was important, there was a lack of clarity about appropriate routine engagement (eg, what lines should be tested), what should be noted in practice infection control records, and steps to be taken in response to a failed test result (ie, ≥ 500 colony-forming units/mL), such as taking a chair out of service.

Conclusions. Survey results showed there were considerable gaps in knowledge and practice that could lead to patient harm. Oral health care provider training may not prepare personnel adequately to engage in, let alone supervise, DWL infection control. DWL infection control, like other aspects of infection control, requires action informed via an understanding of what needs to be done. Although good intentions are appreciated, better approaches to DWL infection control information dissemination and strategies to engage dental assistants, dental hygienists, and dentists in best practices are needed.

Practical Implications. Evolving standards of care, including infection control, should be reflected in the provision of dental treatment. Improvements in communicating and ensuring engagement in best practices are needed when it comes to DWL infection control.

Key Words. Infection control; dental practice; dental general; dental practice management; dental unit waterlines.

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Infection prevention and control measures are important in all facilities providing health care, including oral health care. Infectious challenges in dentistry arise from the constant procedures requiring water and creating aerosols. Although the COVID-19 pandemic heightened awareness about the need for airborne pathogen risk mitigation, the same may not be true for other infection control measures.

Dental unit waterlines (DWLs) are a component of dental operative units and may not be considered a potent source of infection risk. By their nature, DWLs lend themselves to growing and harboring potentially pathogenic microbes, and systemic infections with serious consequences have been traced to them.¹⁻⁵ DWLs provide water to common operatory instrumentation, including high-speed dental handpieces, ultrasonic scalers, air and water syringes, and other devices used during dental treatment. Consideration of water and DWL tubing in the system is critical to strategies for infection prevention.

Results of a 2023 systematic review showed that biofilm accumulation in DWLs is well documented.⁶ Best practices regarding the water to be used in DWLs, protocols for routine DWL flushing and maintenance as well as water testing and treating, are readily available from the Centers for Disease Control and Prevention.⁷⁻⁹ Best-practice recommendations are highlighted regularly in

This article has an accompanying online continuing education activity available at: <http://jada.ada.org/ce/home>.

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online and in-person course offerings and publications available through dental care professional member associations, including the Organization for Safety, Asepsis and Prevention as well as other oral health care stakeholders. In addition, as dental operative units are class I regulated medical devices that require 510(k) submission to the US Food and Drug Administration, validated reprocessing instructions are required to be included at the time of purchase. Guidance on cleaning and disinfection procedures from the manufacturer's reprocessing instructions should be followed as well as package instructions included with reagents to be used.

Despite the importance of DWLs to the safe operation of dental practices, there are discouraging study results about DWL practice. Unpublished results from a convenience sample of dentists attending the 2012 annual meeting of the American Dental Association (ADA) suggested a lack of understanding about the connection between and need for both DWL treatment and DWL testing. Results of a survey of dentists showed that more than 40% monitored DWLs at least yearly,¹⁰ and results from a survey of dental practice staff members showed that only 67% knew the frequency with which their DWLs were tested.¹¹

Given that DWLs provide a favorable environment for the growth of microorganisms and development of biofilm, and documentation of how commonly DWLs were contaminated with organisms with pathogenic potential,⁶ we sought to identify knowledge gaps and understand the challenges and barriers to compliance with best practice among those who supervise DWL infection control as well as those engaged in the hands-on activities involved in DWL infection control.

METHODS

Participants and procedures

We developed a cross-sectional online survey with 2 paths: 1 for those engaged in hands-on infection control activities and 1 for those involved primarily in a supervisory capacity. The survey began with 5 multiple-choice screening questions. The survey path for those involved with the hands-on activities of DWL infection control consisted of 24 multiple-choice questions about systems and protocols; the path for those in a supervisory role had 20 multiple-choice questions. Both paths then had 6 multiple-choice questions about personal and ongoing education or training in DWL infection control, followed by 2 additional questions with open fields for respondents to share their ideas on what might facilitate DWL infection control efforts and to collect any additional insights. Respondents indicating they were dental assistants received an additional question about their training. The ADA institutional review board reviewed all survey components, and the project was categorized as exempt from further institutional review board review. Before distribution using the Qualtrics XM platform (Qualtrics), the survey was pilot tested among 5 dental care professionals to identify questions that were unclear or program logistical issues. A sample size of 200 people per profession with an α of .04 was estimated to have a power of 89.6% to detect differences among professions.

An email was sent to member and nonmember dental hygienists ($\approx 4,700$) and dental assistants ($\approx 5,000$) from the American Dental Hygienists Association and American Dental Assistants Association, respectively, and to 956 dentists who were ADA Clinical Evaluator Panel members. In addition to email solicitations, a written copy containing a link to the survey was placed in member association newsletters and on social media platforms to recruit survey respondents who may not have seen, or been among those receiving, the initial email.

Links to the survey were open for 2 weeks. An automated function in Qualtrics XM sent an email reminder to those initially contacted via email but who had not yet responded to the survey. A total of 600 electronic gift cards (\$25) were offered to the first 200 respondents in each professional group. This was decoupled from the survey instrument to protect participant identity. The optional identifiable information (ie, participant email address) submitted for the electronic gift card was stored on a secure server and was not associated with their survey responses. Anyone younger than 18 years, not an employee of a dental practice, or who indicated they had no role in DWL infection control were excluded from the study.

RESULTS

All DWL survey results, unless indicated in the text, are provided in [Table 1](#) and additional data on backflow prevention practices and evacuation line maintenance are provided in the [eTable](#)

ABBREVIATION KEY

- ADA:** American Dental Association.
CDC: Centers for Disease Control and Prevention.
DWL: Dental unit waterline.

Table 1. Survey questions and responses.

QUESTION AND RESPONSE	NO. (%)*
How Important Is DWL[†] Management/Maintenance?	
Important or very important	771 (85)
Neutral, low, or unimportant	136 (15)
Do You Have a Written Policy and Procedure Manual?	
Yes	492 (61)
No	134 (17)
Do not know	64 (8)
Rely on general knowledge	117 (14)
Does Your Practice Have an Infection Control Coordinator?	
No	391 (44)
Yes	492 (56)
[For those indicating they had an infection control coordinator] What is the profession of the infection control coordinator?	
<i>Dental assistant</i>	344 (65)
<i>Dental hygienist</i>	169 (32)
<i>Dental therapist</i>	47 (7)
<i>Dentist</i>	186 (35)
[For dental assistants only] What training or certification do you have to be a dental assistant?	
<i>Graduate of a Commission on Dental Accreditation–accredited dental assisting program</i>	64 (31)
<i>State licensure or registration</i>	125 (60)
<i>Dental Assisting National Board–certified</i>	54 (26)
<i>On-the-job training</i>	26 (13)
How Confident Are You in Your Ability to Maintain and Test DWLs?	
Completely or mostly confident	546 (72)
Slightly or not at all confident	211 (28)
What Interferes or Prevents You From Regularly Maintaining DWLs?	
Time	207 (27)
It is not needed	92 (12)
Staff member shortages	140 (18)
Product issues	44 (6)
Financial barriers	113 (15)
I do not know how it should be done	31 (4)
Nothing	271 (36)
What Interferes or Prevents You From Regularly Testing or Monitoring DWLs?	
Time	188 (25)
It is not needed	70 (9)
Staff member shortages	139 (18)
Product issues	78 (10)
Financial barriers	113 (15)
I do not know how it should be done	43 (6)
Nothing	258 (34)
How Are DWL Test Results Documented?[‡]	
Digitally (self-recorded)	169 (31)

* Percentages were calculated using the number of responses to the given question as the denominator. † DWL: Dental unit waterline.

‡ Questions were only asked of those reporting hands-on engagement. § CFU: Colony-forming units.

Table 1. Continued

QUESTION AND RESPONSE	NO. (%)*
Digitally (laboratory recorded results)	230 (43)
Written record	299 (55)
No records kept	33 (6)
I do not know	47 (9)
What Information Is Collected When DWL Testing?†	
Test date	299 (65)
Location (ie, chair or operatory number)	329 (72)
Water source	323 (70)
Test results	354 (77)
Waterline maintenance or shock product lot number	140 (31)
Waterline maintenance or shock product name	215 (47)
Volume of water collected from each line	100 (22)
Pooling dilution (whether samples are pooled)	44 (10)
Name of the team member sampling	90 (20)
What Resources Were Used to Develop Your Maintenance and Testing or Monitoring Protocols?	
Dental unit manufacturer instructions	336 (66)
Dental waterline treatment product instructions	344 (68)
Staff members gathered materials‡	179 (50)
A consultant was engaged	155 (30)
Local, state, or Centers for Disease Control and Prevention guidance	245 (48)
Compliance software program	43 (8)
Unknown	26 (5)
Do You Have a Standard Protocol for When Results of a DWL Test Are ≥ 500 CFU[§]/mL?	
Yes	439 (56)
No	216 (28)
Unknown	128 (16)
Do your DWL Infection Control Practices Follow Centers for Disease Control and Prevention Recommendations?	
Yes	238 (54)
No	77 (17)
I do not know	127 (29)
What Type of Water Is Used in Your Dental Unit?	
Tap water or municipal water	252 (32)
Distilled water	410 (51)
Deionized water	152 (19)
Commercial or developed bottled water	143 (18)
In-office filtration system	175 (22)
Building filtration system	74 (9)
I do not know	16 (2)
What DWL Treatment Methods Do You Use?	
Daily maintenance products	449 (56)
Continuous maintenance products (straw, cartridge)	407 (51)

Table 1. Continued

QUESTION AND RESPONSE	NO. (%)*
Periodic shock	355 (45)
Do not routinely use any DWL treatment	28 (4)
I do not know	26 (3)
What Is the Frequency of Routine Testing or Monitoring?	
Weekly	181 (23)
Monthly	184 (23)
Quarterly	222 (28)
After new waterline or equipment is installed	186 (23)
After a failed test (≥ 500 CFU/mL)	160 (20)
Due to a specific circumstance (eg, boil water advisory)	134 (17)
I do not know	79 (10)
Never	56 (7)
What Methods Are Used to Test or Monitor Your DWLs?	
External laboratory (mail-in) testing	334 (45)
In-office or chairside testing	408 (55)
I do not know	103 (14)
When Are Shock Treatments Performed?	
Daily	155 (20)
Weekly	137 (17)
Monthly	163 (21)
Quarterly	110 (14)
Yearly	43 (5)
After new waterlines are placed	101 (13)
After equipment is installed	152 (19)
After a failed test (≥ 500 CFU/mL)	197 (25)
Due to a specific circumstance (eg, boil-water advisory)	84 (11)
I do not know	58 (7)
Never	47 (6)
Have You Ever Had a Failed Test Result (ie, ≥ 500 CFU/mL)?	
Yes	317 (40)
No	341 (43)
I do not know	127 (16)
What Actions Are Taken After a Second Failed Test After Shocking a Waterline?	
Replace waterline	234 (30)
Place a service call	302 (39)
Shock and test again	390 (50)
Take unit out of service	219 (28)
I do not know	130 (17)
Which Lines That Supply Water for Patient Treatment Do You Test?*	
None	10 (2)
High-speed handpieces (that use water)	322 (59)
Air or water syringes	345 (63)
Ultrasonic scalars	311 (57)

Table 1. Continued

QUESTION AND RESPONSE	NO. (%) [*]
Only lines used during treatment	100 (18)
Lines from source water	73 (13)
I do not know	29 (5)
Are Water Samples Collected and Tested From Individual Lines or Are Samples Pooled (and, If So, How)?[‡]	
Individual lines	181 (31)
Multiple lines, pooled from the same unit	235 (40)
Multiple lines, pooled from multiple units	88 (15)
I do not know	83 (14)
For Those Pooling Samples, How Are the Samples Managed?[‡]	
Variable amounts from each line	90 (30)
Equal amounts from each line	192 (64)
I do not know	13 (4)
When Do You Flush DWLs?[‡]	
Daily at an unspecified time	147 (26)
2 min at the start of the day	268 (47)
2 min at the end of the day	145 (26)
20-30 s between patients	245 (43)
Per product instructions	75 (13)
Never	15 (3)

(available online at the end of this article). A link to the survey was emailed directly to an estimated 10,700 members of the oral health care team and was made accessible to an additional unknown number of people through association newsletters and social media posts. The numbers of dentists, dental hygienists, and dental assistants completing the survey as well as the proportions involved in hands-on activities or in supervisory roles, are shown in Table 2 and may represent fewer than 7% of those eligible to participate.

Results from the 3 professions (Table 1) were pooled due to concern about potential sampling bias affecting inferential analysis, given that the response rates for dentists, dental hygienists, and dental assistants were 30.2%, 5.5%, and 3.7%, respectively. Most respondents (85%) indicated that DWL infection control was important to patient care. More than one-half of respondents (61%) indicated having a policy and procedure manual for maintaining and testing DWL, and 56% indicated that there was a specific person designated to oversee DWL infection control; the profession of this person was most often a dental assistant (65%), followed by dental hygienists and dentists at 32% and 35%, respectively. A total of 7% indicated that a dental therapist performed this role. Most dental assistants had state licensure or registration (60%), although only 31% were graduates of a Commission on Dental Accreditation–accredited dental assisting program and 13% were trained on the job.

In terms of their ability to maintain and test DWLs, 72% of respondents were mostly or completely confident in both maintenance and testing, which were queried separately. In terms of DWL maintenance, 36% indicated that nothing interfered, and in terms of testing, 34% indicated that nothing interfered. For those who reported experiencing problems, the most reported issues were time constraints, lack of directions or guidance, staff member shortages, and financial issues.

A total of 15% of respondents with a hands-on role in DWL infection control activities reported not knowing the need for or not keeping DWL maintenance and testing records. Of those who reported maintaining records, 31% maintained their own test results digitally, 43% had digital results from an outside testing laboratory, and 55% kept written records. In terms of what was recorded, test results were the most common (77%), followed by the location (ie, chair or operatory number [72%]), water source (70%), and test date (65%). Much less frequently recorded were the

Table 2. Number of survey respondents and their role in dental unit waterline infection control according to profession.

PROFESSION	TOTAL, NO.	HANDS-ON ENGAGEMENT, NO.	SUPERVISORY, NO.	OTHER, NO.
Dentist	289	176	106	7
Dental Hygienist	257	227	19	11
Dental Assistant	187	173	11	3

Table 3. Respondents' ability to report accurately on whether they practice in a state requiring compliance with CDC* dental unit waterline infection control recommendations.

VARIABLE	CORRECTLY INDICATED WHETHER THEIR STATE REQUIRES FOLLOWING ALL CDC RECOMMENDATIONS, NO. (%)	INCORRECTLY INDICATED WHETHER THEIR STATE REQUIRES FOLLOWING ALL CDC RECOMMENDATIONS, NO. (%)	DID NOT KNOW WHETHER THEIR STATE REQUIRES FOLLOWING ALL CDC RECOMMENDATIONS, NO. (%)
Respondents From a State That Requires Following All CDC Recommendations†	238 (45)	162 (31)	127 (24)
Respondents From a State That Does Not Require Following All CDC Recommendations	78 (31)	117 (47)	56 (22)

* CDC: Centers for Disease Control and Prevention. † States and districts that require as state law that all CDC recommendations be followed: Alabama, Arizona, Colorado, Connecticut, Washington DC, Georgia, Hawaii, Idaho, Indiana, Kentucky, Louisiana, Massachusetts, Maryland, Maine, Minnesota, Missouri, Mississippi, Montana, North Carolina, North Dakota, New Jersey, New Mexico, Nevada, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Texas, Virginia, and Wyoming. States that require compliance with their own infection control acts: Arkansas, California, Delaware, Florida, Illinois, Kansas, Michigan, Nebraska, Ohio, Utah, Wisconsin, and West Virginia. States that require as state law that some CDC recommendations be followed: Arizona, Indiana, Tennessee, Vermont, and Washington.

water maintenance or shock product lot number, water volume collected, pooling dilution, and team member collecting the sample.

Although 30% reported consultants had been engaged in the compilation of the practice protocols, 14% reported relying on office staff member knowledge rather than have a set of curated protocols. Commonly practiced protocols for infection control included materials from dental unit manufacturer instructional resources (66%) and DWL treatment product manufacturers (68%). In terms of standard protocols, only 56% of office resources had a protocol for when there was a failed test (ie, ≥ 500 colony-forming units [CFU]/mL).

In terms of the role of Centers for Disease Control and Prevention (CDC) recommendations, 54% indicated their practice followed CDC recommendations. Of those in states that follow CDC guidance, 45% accurately indicated so, as shown in Table 3.


A little more than one-half of the respondents (51%) indicated that the practice in which they worked used distilled water as the water source for their dental units (Table 1). Other commonly reported water sources were municipal water (32%), deionized water (19%), commercially bottled water (18%), and water that has been through a US Food and Drug Administration–approved filtration system (22%). In terms of routine water treatment, some practices reported using multiple approaches, possibly in different operatories or chairs. Daily maintenance products (56%), continuous maintenance products (straw, cartridge) (51%), and periodic shock treatment (45%) were all commonly used.

In terms of frequency of routine testing, weekly (23%), monthly (23%), and quarterly (28%) were common, with 17% indicating that they did not know how often water was tested or that they did not routinely test their water. Fewer than 25% of respondents reported testing when a new waterline or equipment was installed, after a failed test (ie, ≥ 500 CFU/mL), or after a specific circumstance, such as a boil-water advisory. For those practices engaging in routine testing, 45% mailed samples to an external laboratory for analysis, and 55% conducted in-office or chairside testing.

There was near-equal division for daily, weekly, and monthly frequency for when shock treatments were routinely conducted (20%, 17%, 21%, respectively) dropping to 14% and 5% for quarterly and yearly routine shock treatment. In terms of nonroutine shock treatment, 13% reported doing a shock treatment when new waterlines are placed, 19% when new equipment or dental units are installed, 25% after receipt of a failed DWL test (≥ 500 CFU/mL), and 11% after a specific

Dental unit waterline infection control


A guide to dental water infection control from the **American Dental Association** and **HuFriedyGroup**




Every practice should have a designated infection control coordinator

Every practice should have a policy and procedure manual for maintaining dental unit waterlines.

Where should they come from?	What should be included?
Centers for Disease Control and Prevention, state, and local guidance ✓	Frequency of dental waterlines testing ✓
Dental waterline treatment products ✓	Remediation protocol after failed testing (results \geq 500 CFU/mL) ✓
Dental unit manufacturer instructions ✓	What to do in the event of a boil-water advisory ✓
Secondhand knowledge ✗	Special circumstance protocol (boil water, extended office closure) ✓



Water used in dental units should have < 500 CFU/mL



Which lines should be tested?

- High-speed handpiece lines ✓
- Air or water syringe lines ✓
- Ultrasonic scaler lines ✓
- Source water ✓
- Evacuation lines ✓
- Unused waterlines ✓

When should dental unit waterlines be flushed?

- According to manufacturers' instructions for use...
- 20-30 seconds after each patient...
- 2 minutes at the end of each day...
- After the final patient of the day...

In addition, waterlines should be emptied and dried overnight to remove as much water as possible.

What to document when testing dental unit waterlines

- Test date.....
- Location (ie, chair or operatory no.).....
- Water source.....
- Test results.....
- Waterline maintenance or shock product name.....
- Waterline maintenance or shock product lot no.....
- Pooling details* (if samples pooled).....
- Name of team member sampling.....

Figure. Centers for Disease Control and Prevention dental unit waterline infection control guidance. Source: Centers for Disease Control and Prevention.⁷⁻⁹ * Samples from multiple waterlines that are then combined for testing. CFU: Colony-forming unit.

circumstance, such as a boil-water advisory. In terms of having received a failed test (ie, \geq 500 CFU/mL), 40% of respondents indicated that they had received one. Actions reported after a confirmatory failed test included a shock treatment and repeat testing (50%), placing a service call (39%), replacing the waterlines of the unit (30%), and taking the unit out of service (28%).

Among those indicating that they were involved in hands-on maintenance and testing, 18% indicated they only test lines used during treatment; in terms of the specific lines reported to be tested routinely, these included lines to high-speed handpieces that use water (59%), lines to air or water syringes (63%), ultrasonic scalers (57%), and lines from the water source to the dental unit (13%). For sample number management, 31% reported testing samples from individual lines, 40% reported pooling samples from multiple lines on the same dental unit or water bottle, and 15%

reported pooling samples from different dental units. For those pooling samples, 64% used equal amounts from each line included. Although these were people self-reporting involvement in the process, 14% reported not knowing how the water samples were collected. Nearly one-half (47%) indicated flushing DWL lines for 2 minutes at the beginning of each day and for 20 through 30 seconds between patients (43%), 26% reported flushing the DWL for 2 minutes at the end of the day, and an additional 13% reported flushing the DWL in accordance with product instructions.

The figure presents our high-level summary of CDC guidance.⁷⁻⁹

DISCUSSION

The purpose of our study was to identify challenges of and barriers to engagement in DWL infection control processes to maintain safe patient treatment water. Obstacles such as staff member shortages, time, and financial constraints were mentioned, but survey responses about actions revealed an incomplete understanding of CDC guidance, failed appreciation that recommendations are modified to reflect new evidence, and, although considering DWL infection control to be important, failed to engage in ways that are effective. For example, in 1993, flushing waterlines at the beginning and end of the day was recommended.¹² However, in 2003, after new data indicated that 500 CFU/mL or less cannot be achieved with this approach alone, the CDC added guidance that use of chemical germicides, flushing lines between patients, and quality source water use were necessary to maintain the regulatory standard for safe drinking water.⁸

The recommendation from the CDC to “Assign at least one individual trained in infection prevention responsibility for coordinating the program,”⁹ provides an example of a substantial proportion of practices simply not being in alignment with best practice, as 32% of respondents indicated their practice did not have someone assigned to this responsibility. This is a decrease in alignment compared with survey results published in 2012.¹³ When we asked whether the dental practice had a written policy and procedure manual for maintaining and testing and monitoring DWL (another CDC recommendation), 22% indicated they either did not know or did not have one. Although it would appear self-evident that a dental unit with DWL test results 500 CFU/mL or higher should be taken out of use until the problem is resolved, fewer than one-half of respondents indicated they did so. Notwithstanding inclusion of DWL infection control in oral health care provider curricula and regular offerings both in-person and online for continuing education credit from dental care professional associations (eg, ADA, American Dental Hygienists’ Association, American Dental Assistants Association, and Organization for Safety, Asepsis and Prevention) and authoritative organizations, such as the CDC, based on these results, a substantial subset of providers are not following best DWL infection control practice. The geographic variation in the recommendations that apply to practices due to differing rules and regulations from various state dental boards may contribute to the challenge of conveying clear and easy-to-follow guidance. Regardless of this geographic variation, educating about best practices consistent with up-to-date recommendations can help standardize the knowledge base of oral health care personnel resulting in effective DWL management, even if beyond state rules and regulations.

Our results showed that dental assistants were actively engaged in DWL infection control efforts, including a subset in a supervisory role. Given that there are no standard requirements for dental assistants from state to state, DWL infection control training, registration, or licensure, and that 13% indicated they were trained as dental assistants on the job, there is no assurance that their knowledge base is up-to-date with recommendations. However, there also appears to be overconfidence about best practices on the part of dentists and dental hygienist.

Record keeping is another particularly problematic area in that 15% of respondents with hands-on engagement reported they either did not keep records or they did not know how test results were documented. Only 72% indicated that their records included information, such as the specific DWL unit from which the samples were collected, and 15% indicated that they did not record test results. Fewer than one-half included sufficient information that would allow for appropriate troubleshooting should a failed test result be received.

Although problematic, perhaps record keeping offers an opportunity that could be leveraged to improve engagement in best-practice DWL infection control by means of providing clearer, prescriptive recommendations. There would likely be use in an automatically customizable spreadsheet generated when the practice infection control coordinator or other responsible staff member entered

the dental unit model and manufacturer, water treatment and water testing reagents used, and practice location, including state and county. From this, a record keeping document could be generated with fields for collecting the relevant information, including state board requirements or CDC recommendations. A document or application of this sort would be a prompt to record specific information and serve as a reminder of best-practice action frequency.

It is incumbent on all oral health care providers to have an understanding about what is necessary so that the water used during dental procedures is not exposing patients to unnecessary infection risk. This is as true for those engaged in the hands-on activities of testing and treating DWL as well as for those supervising this work.

The COVID-19 pandemic has put infection control in the forefront of dental care professionals' minds, which might mean they are more receptive to guidance updates and education on specific challenges, including DWL infection control. Although information about specific adverse events traced to DWL^{1,3,4} with insight on consequences, such as hospitalization and patient death, can underscore the importance of DWL infection control and make a compelling case for mindful engagement, there should also be recognition that it is probable that the patient may never associate less severe infections or latent infections that occur weeks or even months after exposure with the appointment. Such events might never be identified as a dental practice adverse event. Modeling requirements after medical reporting requirements could be a way to identify the issues that are present in dentistry and bring patient safety to the next level. Oral health care providers engage in a variety of challenging and complicated activities in their provision of patient care. Although DWL infection control has multiple components, it should be well within the capacity of the oral health care team members to adhere to best practices and identify and report adverse events that may be related to DWL. Perhaps DWL infection control best-practice compliance could be leveraged to a population with heightened awareness of immunocompromise.

Our study had several limitations. By design, those participating in the study were a self-selected cohort and may not be representative of all oral health care providers in practice. The observations reported are all based on self-report and were not verified. Additional documentation of engagement and improved participation in DWL infection control best practices would be prudent.

CONCLUSIONS

Our results showed gaps in knowledge and practice that can lead to patient harm. Oral health care provider training may not prepare personnel adequately to engage in, let alone supervise, DWL infection control. DWL infection control, like other aspects of infection control, requires action informed via an understanding about what needs to be done. Although good intentions are appreciated, better approaches to DWL infection control information dissemination and strategies to engage oral health care providers in best practices are needed. ■

DISCLOSURES

Dr. Carsten is the chairperson of the Infection Control in the Dental Commission for the Washington State Department of Health. Ms. Stream lectures and consults widely on infection control in dental practice. None of the other authors reported any disclosures.

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1. Outbreaks of nontuberculous mycobacteria infections highlight importance of maintaining and monitoring dental waterlines. Centers for Disease Control and Prevention Health Alert Network; 2022. Last reviewed October 31, 2022. Accessed October 27, 2023. <https://emergency.cdc.gov/han/2022/han00478.asp>
2. Hatzenbuehler LA, Tobin-D'Angelo M, Drenzek C, et al. Pediatric dental clinic-associated outbreak of *Mycobacterium abscessus* infection. *J Pediatric Infect Dis Soc*. 2017;6(3):e116-e122. doi:10.1093/jpids/pix065
3. Peralta G, Tobin-D'Angelo M, Parham A, et al. Notes from the field: *Mycobacterium abscessus* infections among patients of a pediatric dentistry practice—Georgia, 2015. April 8, 2016. Accessed December 21, 2021. <http://www.cdc.gov/mmwr/volumes/65/wr/mm6513a5.htm>
4. Ricci ML, Fontana S, Pinci F, et al. Pneumonia associated with a dental unit waterline. *Lancet*. 2012; 379(9816):684.
5. Singh J, O'Donnell K, Nieves DJ, et al. Invasive *Mycobacterium abscessus* outbreak at a pediatric dental clinic. *Open Forum Infect Dis*. 2021;8(6):ofab165.
6. Bayani M, Raisolvaezin K, Almasi-Hashiani A, Mirhoseini SH. Bacterial biofilm prevalence in dental unit waterlines: a systematic review and meta-analysis. *BMC Oral Health*. 2023;23(1):158.
7. Centers for Disease Control and Prevention. Recommended infection-control practices for dentistry, 1993. *MMWR Recomm Rep*. 1993;42(RR-8):1-12.
8. Centers for Disease Control and Prevention. Guidelines for infection control in dental health-care settings: 2003. *MMWR*. 2003;52(RR-17). Accessed December 21, 2021. <http://www.cdc.gov/mmwr/PDF/rr/rr5217.pdf>
9. Summary of infection prevention practices in dental settings: basic expectations for safe care. Centers for Disease Control and Prevention. October 2016. Accessed March 14, 2019. <https://www.cdc.gov/oralhealth/infectioncontrol/pdf/safe-care2.pdf>
10. Cleveland JL, Foster M, Barker L, et al. Advancing infection control in dental care settings: factors associated with dentists' implementation of guidelines from the Centers for Disease Control and Prevention. *JADA*. 2012; 143(10):1127-1138.
11. Posada CJ, Boyd LD, Perry KR, Vineyard J. Knowledge, attitudes, practices of dental professionals regarding the infection control guidelines for dentistry prior to the COVID-19 pandemic. *J Dent Hyg*. 2021; 95(3):25-32.
12. Centers for Disease Control and Prevention. Recommended infection-control practices for dentistry, 1993. *MMWR Recomm Rep*. 1993;42(RR-8):1-12.
13. Cleveland JL, Bonito AJ, Corley TJ, et al. Advancing infection control in dental care settings: factors associated with dentists' implementation of guidelines from the Centers for Disease Control and Prevention. *JADA*. 2012;143(10): 1127-1138.

eTable. Responses to survey questions on backflow prevention and evacuation line maintenance.

SURVEY QUESTIONS AND RESPONSES	NO. (%)
43/78. Do You Use a Backflow Prevention Device With Your Saliva Ejector During Patient Procedures? (Not the High-Volume Suction)	
Yes	472 (63)
No	283 (37)
42/77. Do You Ask Patients to Close Their Lips Around the Tip of the Saliva Ejector During Suction Use and Procedures?	
Yes	519 (68)
No	234 (31)
44/79. Do You Use Low-Volume Suction Simultaneously With High-Volume Evacuation?	
Yes	473 (63)
No	280 (37)
45/80. Do You Have a Maintenance Protocol for the Evacuation Line Cleaning?	
Yes	585 (82)
No	130 (18)
46/81. How Often Do You Clean Your Evacuation Lines?	
After each patient	144 (22)
Daily	285 (43)
Weekly	146 (22)
Monthly	67 (10)
I do not know	18 (3)