Dental practices use disinfectants or line cleaners to flush dental unit wastewater lines and wastewater plumbing to minimize odor generation and to remove solid waste particles. They also use these agents to remove biofilms in dental unit waterlines (DUWLs) and to maintain low microbial counts in dental unit water.

The release of mercury from amalgam occurs when some types of disinfectants and line cleaners come into contact with amalgam waste that has collected in chairside traps, dental unit waste line tubing, vacuum pump filters, amalgam separators (if installed) and wastewater plumbing. Because of growing environmental concerns, the U.S. Environmental Protection Agency (EPA) requires that publicly owned treatment works (POTWs)—that is, wastewater treatment facilities—meet increasingly stringent numeric limits for mercury in wastewater. In their compliance efforts, POTWs have identified dental office wastewater as a source of mercury in wastewater.1

Most mercury in dental office wastewater occurs in the form of dental amalgam that is captured by POTWs in grit chambers and as biosolids. However, dissolved mercury, which the EPA defines as mer-
cury that can pass through a 0.45-micrometer filter, is too small to be captured by POTWs. As a result, dissolved mercury often appears in POTW effluent. Because disinfectants and line cleaners could react with amalgam waste to release dissolved mercury, choosing disinfectants and line cleaners that release little or no mercury from amalgam waste is a prudent approach.

Kielbassa and colleagues and Kummerer and colleagues reported that three of seven disinfectants caused more mercury release than water when either came in contact with amalgam waste in dental units. The investigators concluded that disinfectants containing oxidizing agents release mercury from amalgam. In an in vitro study, Rotstein and colleagues reported that hypochlorite solutions released mercury from amalgam. Roberts and colleagues reported that six of the eight disinfectants used in their laboratory study released more mercury from ground amalgam particles than did the water control. A disinfectant containing quaternary ammonium compounds released less mercury from amalgam than did water. Additionally, a combination of phenolic compounds released similar amounts of mercury from amalgam as did water. Disinfectants that contain chlorine, bromine, iodophor peroxide/peracetic acid and some phenolic compounds released more mercury from amalgam particulate than did the control (water). Stone and colleagues reported that iodine, found in some DUWL treatment formulations, released mercury from amalgam. The American Dental Association’s Best Management Practices for Amalgam Waste recommend against using chlorine-containing line cleaners.

Our study involved the evaluation of 47 disinfectants or line cleaners for their potential to release mercury from amalgam waste. This report is intended to help dental professionals make product choices that minimize mercury release.

MATERIALS AND METHODS
We used deionized water as the control. The table lists the products, manufacturers, intended use, active ingredients and recommended concentration for use. We prepared each product concentration according to the manufacturer’s recommendations. We measured the pH of each preparation using an Accumet Model 15 pH meter and Accumet pH electrode (Fisher Scientific International, Hampton, N.H.). We prepared cylindrical amalgam specimens measuring 4 × 7 millimeters using Tytin (lot no. 3-2239, Kerr, Orange, Calif.) according to American National Standards Institute/American Dental Association Specification No. 1-2003. We aged the amalgam cylinders for seven days in air at 25 ± 2°C. We measured the diameter and height of each specimen using a micrometer (Mitutoyo Model no. CD-6 in. CS, Mitutoyo USA, Aurora, Ill.) and calculated the surface area of each amalgam cylinder (113.10 ± 1.03 square millimeters). We placed each amalgam specimen in a polypropylene vial measuring 76 × 20 mm (Sarstedt, Newton, N.C.), containing 5.5 milliliters of disinfectant or line cleaner preparation. We prepared five samples of each disinfectant or line cleaner. We placed the vials on a rocking platform (Rocking Platform, Model 100, VWR Scientific, Philadelphia) and gently agitated them for 24 hours. We decanted the solution and separated the amalgam cylinder and rinsed the empty vials with 2.5 mL of 10 percent nitric acid/0.02 percent potassium dichromate. We combined the decanted liquid and rinse, filtered the mixture through 0.45-µm Teflon filters (National Scientific, Rockwood, Tenn.) and analyzed it for mercury using modified EPA method 245.1. We analyzed every disinfectant or line cleaner and calculated the amount of mercury released per unit surface area each time.

We performed statistical analysis using a one-way analysis of variance and multiple comparisons (Student-Newman-Keuls), and we determined the correlation coefficient ($r^2$) for pH versus the mean amount of mercury released.

RESULTS
The table summarizes the amounts of mercury released per unit surface area of amalgam after 24 hours and the pH values of the disinfectant or line cleaner preparations. Six preparations released significantly more mercury from amalgam (about 17 to 340 times) than did the deionized water control ($P < .001$). The amount of mercury released by the other line cleaners or disinfectants was not statistically different from that released by the control. The pH values of all preparations ranged from 1.76 to 12.35.

DISCUSSION
In this study, six disinfectant or line cleaner preparations released significantly more mercury from amalgam than did the control, which was deionized water. Three of these disinfectant or line cleaner preparations contained sodium...
<table>
<thead>
<tr>
<th><strong>LINE CLEANER/ DISINFECTANT BRAND NAME</strong></th>
<th><strong>MANUFACTURER</strong></th>
<th><strong>INTENDED USE</strong></th>
<th><strong>ACTIVE AGENTS (MANUFACTURER-REPORTED)</strong></th>
<th><strong>LINE CLEANER/ DISINFECTANT PREPARATION</strong></th>
<th><strong>pH</strong></th>
<th><em><em>MEAN MERCURY RELEASED ng/mm²</em> (SD†)</em>*</th>
<th><strong>DIFFERENCE BETWEEN PRODUCTS‡</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Compliance</td>
<td>Metrex Research (Orange, Calif.)</td>
<td>Disinfectant</td>
<td>7.35% hydrogen peroxide, 0.23% peracetic acid</td>
<td>No dilution</td>
<td>1.76</td>
<td>471.69 (13.46)</td>
<td>NA†</td>
</tr>
<tr>
<td>Clorox (Ultra)</td>
<td>Clorox (Oakland, Calif.)</td>
<td>Disinfectant/cleaner</td>
<td>6% Sodium hypochlorite</td>
<td>200 to 1,800 milliliters DI water</td>
<td>10.72</td>
<td>46.42 (21.97)</td>
<td>NA</td>
</tr>
<tr>
<td>Discide TB</td>
<td>Palmero Health Care (Stratford, Conn.)</td>
<td>Disinfectant/cleaner</td>
<td>0.154% Quaternary ammonium chloride, 0-5% EDTA#</td>
<td>No dilution</td>
<td>11.96</td>
<td>33.81 (0.00)</td>
<td>A</td>
</tr>
<tr>
<td>Vac Attack</td>
<td>Premier Dental (Plymouth Meeting, Pa.)</td>
<td>Line cleaner</td>
<td>&lt;10% Sodium dichloroisocyanate dihydrate</td>
<td>16.9 grams to 2,000 mL DI water</td>
<td>11.05</td>
<td>29.93 (8.41)</td>
<td>A</td>
</tr>
<tr>
<td>Sanogene</td>
<td>Biocide International (London)</td>
<td>Disinfectant</td>
<td>Sodium chloride, chlorine dioxide</td>
<td>12.5 mL and 0.75 g activator to 500 mL DI water</td>
<td>2.59</td>
<td>23.73 (1.56)</td>
<td>A,B</td>
</tr>
<tr>
<td>Dispatch</td>
<td>Caltech Industries (Midland, Mich.)</td>
<td>Line cleaner</td>
<td>&lt;1% Sodium hypochlorite</td>
<td>No dilution</td>
<td>12.35</td>
<td>23.63 (21.00)</td>
<td>A,B</td>
</tr>
<tr>
<td>DentaPure DP90</td>
<td>MRLB International (River Falls, Wis.)</td>
<td>DUWL** cleaner</td>
<td>Iodine 2-6 ppm††</td>
<td>Filtrate from Denta Pure DP90</td>
<td>6.95</td>
<td>15.00 (0.15)</td>
<td>B,C</td>
</tr>
<tr>
<td>Maxicide Plus</td>
<td>Henry Schein (Melville, N.Y.)</td>
<td>Disinfectant</td>
<td>3.4% Glutaraldehyde</td>
<td>Activator added to 3.785 liters of Maxicide Plus</td>
<td>8.00</td>
<td>5.05 (0.005)</td>
<td>C</td>
</tr>
<tr>
<td>Biocide C30</td>
<td>Biotrol (Earth City, Mo.)</td>
<td>Disinfectant</td>
<td>2.65% Glutaraldehyde</td>
<td>No dilution</td>
<td>6.17</td>
<td>4.68 (0.76)</td>
<td>C</td>
</tr>
<tr>
<td>MicroClear</td>
<td>Rowpar Pharmaceuticals (Scottsdale, Ariz.)</td>
<td>DUWL cleaner</td>
<td>Chlorine dioxide</td>
<td>50 mL to 500 mL DI water</td>
<td>6.65</td>
<td>4.58 (0.15)</td>
<td>C</td>
</tr>
<tr>
<td>Bi-Arrest III</td>
<td>Infection Control Technology (Woods Cross, Utah)</td>
<td>Disinfectant/cleaner</td>
<td>0.06% o-phenyl phenol, 0.05% p-tertiary amyl phenol</td>
<td>2 mL to 500 mL DI water</td>
<td>10.09</td>
<td>4.45 (0.01)</td>
<td>C</td>
</tr>
<tr>
<td>Banicide</td>
<td>Pascal (Bellevue, Wash.)</td>
<td>Disinfectant</td>
<td>3.5% Glutaraldehyde</td>
<td>As is</td>
<td>6.21</td>
<td>4.40 (0.29)</td>
<td>C</td>
</tr>
<tr>
<td>Metricide Plus</td>
<td>Metrex Research</td>
<td>Disinfectant</td>
<td>3.4% Glutaraldehyde</td>
<td>Add activator to 3.8 L of Metricide Plus</td>
<td>7.99</td>
<td>4.07 (0.08)</td>
<td>C</td>
</tr>
<tr>
<td>Microstat2</td>
<td>Septodont (New Castle, Del.)</td>
<td>Line cleaner</td>
<td>Sodium bromide, dimethylhydantoin, potassium bicarbonate, sodium bisulfate</td>
<td>2 tablets of 2A and 2 tablets of 2B to 1892.8 mL DI water</td>
<td>6.83</td>
<td>3.23 (0.90)</td>
<td>C</td>
</tr>
<tr>
<td>Sterilex Ultra</td>
<td>Sterilex (Owings Mills, Md.)</td>
<td>DUWL cleaner</td>
<td>Quaternary ammonium chloride, sodium carbamate peroxide</td>
<td>5.5 bottles of solution 1 to 5.5 bottles of solution 2</td>
<td>10.10</td>
<td>1.48 (0.02)</td>
<td>C</td>
</tr>
<tr>
<td>Water (Deionized)</td>
<td>None</td>
<td>Control</td>
<td>N/A</td>
<td>N/A</td>
<td>4.93</td>
<td>1.36 (0.21)</td>
<td>C</td>
</tr>
</tbody>
</table>

* ng/mm²: Nanograms per square millimeter.
† SD: Standard deviation.
‡ There was no significant difference between products with the same letters.
§ N/A: Not applicable.
¶ DI: Deionized
# EDTA: Ethylenediaminetetraacetic acid.
** DUWL: Dental unit waterline.
†† ppm: Parts per million.

Continued on next page
<table>
<thead>
<tr>
<th>LINE CLEANER/ DISINFECTANT BRAND NAME</th>
<th>MANUFACTURER</th>
<th>INTENDED USE</th>
<th>ACTIVE AGENTS (MANUFACTURER-REPORTED)</th>
<th>LINE CLEANER/ DISINFECTANT PREPARATION</th>
<th>pH</th>
<th>MEAN MERCURY RELEASED ng/mm²** (SD†)</th>
<th>DIFFERENCE BETWEEN PRODUCTS‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Envirocide</td>
<td>Envirosafe Manufacturing (West Melbourne, Fla.)</td>
<td>DUWL cleaner</td>
<td>Quaternary ammonium, chloride, 17-2% isopropyl alcohol, ethylene glycol</td>
<td>No dilution</td>
<td>11.45</td>
<td>1.05 (0.00)</td>
<td>C</td>
</tr>
<tr>
<td>Vacusol Ultra</td>
<td>Biotrol</td>
<td>Line cleaner</td>
<td>Quaternary ammonium, EDTA, sodium meta silicate</td>
<td>40 mL to 2,000 mL DI water</td>
<td>10.54</td>
<td>1.01 (0.36)</td>
<td>C</td>
</tr>
<tr>
<td>BirexSE</td>
<td>Biotrol</td>
<td>Line cleaner</td>
<td>Tertiary amyl phenol</td>
<td>7.8 mL to 2,000 mL DI water</td>
<td>1.98</td>
<td>0.77 (0.21)</td>
<td>C</td>
</tr>
<tr>
<td>SRG Evacuation System Cleaner</td>
<td>Icon Laboratoires (Farmingdale, N.Y.)</td>
<td>Line cleaner</td>
<td>15% Phosphoric acid, 10% glycolic acid</td>
<td>60.6 mL to 2,000 mL DI water</td>
<td>3.27</td>
<td>0.72 (0.43)</td>
<td>C</td>
</tr>
<tr>
<td>Asepti TB</td>
<td>Ecolab     (St. Paul, Minn.)</td>
<td>Disinfectant/ cleaner</td>
<td>&lt;1 % Quaternary ammonium chloride</td>
<td>No dilution</td>
<td>5.58</td>
<td>0.55 (0.77)</td>
<td>C</td>
</tr>
<tr>
<td>E-Vac Evacuation System Cleaner Concentrate</td>
<td>L&amp;R Manufacturing (Kearny, N.J.)</td>
<td>Line cleaner</td>
<td>20-30% Ortho phosphoric acid, 1-5% isopropyl alcohol, 60-70% water, 0.5% sodium butoxy ethoxy acetate</td>
<td>64.5 mL to 2,000 mL DI water</td>
<td>1.85</td>
<td>0.51 (0.41)</td>
<td>C</td>
</tr>
<tr>
<td>GC Spray-Cide</td>
<td>GC America (Alsip, Ill.)</td>
<td>Line cleaner</td>
<td>21% Isopropyl alcohol, alkyl dimethyl benzyl ammonium chloride, ethylene glycol mono ethyl ether</td>
<td>No dilution</td>
<td>5.75</td>
<td>0.47 (0.52)</td>
<td>C</td>
</tr>
<tr>
<td>Madacide-FD</td>
<td>Mada Medical (Carlstadt, N.J.)</td>
<td>Disinfectant/ cleaner</td>
<td>0.308% Quaternary ammonium chloride, 21% isopropyl alcohol</td>
<td>No dilution</td>
<td>6.55</td>
<td>0.46 (0.36)</td>
<td>C</td>
</tr>
<tr>
<td>ProE-Vac</td>
<td>Certol International (Commerce City, Colo.)</td>
<td>Line cleaner</td>
<td>&lt;10% Phosphoric acid, &lt;10% glycolic acid, &lt;10% isopropyl alcohol</td>
<td>64.5 mL to 2,000 mL DI water</td>
<td>1.93</td>
<td>0.41 (0.19)</td>
<td>C</td>
</tr>
<tr>
<td>Patterson Brand</td>
<td>Patterson Dental (St. Paul, Minn.)</td>
<td>Line cleaner</td>
<td>15% Phosphoric acid, 10% glycolic acid</td>
<td>31.7 mL to 2,000 mL of DI water</td>
<td>2.15</td>
<td>0.37 (0.13)</td>
<td>C</td>
</tr>
<tr>
<td>Turbo-Vac</td>
<td>Pinnacle Products (Lakeville, Minn.)</td>
<td>Line cleaner</td>
<td>Hydrochloric acid, glutaraldehyde</td>
<td>60.6 mL to 2,000 mL DI water</td>
<td>2.60</td>
<td>0.31 (0.08)</td>
<td>C</td>
</tr>
<tr>
<td>Cavidie</td>
<td>Metrex Research</td>
<td>Line cleaner</td>
<td>17-20% Isopropyl alcohol, 3% ethylene glycol monooethyl ether, 0.3% quaternary ammonium chloride</td>
<td>No dilution</td>
<td>10.54</td>
<td>0.30 (0.03)</td>
<td>C</td>
</tr>
<tr>
<td>Vacuum Clean</td>
<td>Palmero Health Care</td>
<td>Line cleaner</td>
<td>40% Dimethyl benzyl ammonium chloride</td>
<td>20 tablets to 1,892.8 mL DI water</td>
<td>6.59</td>
<td>0.26 (0.10)</td>
<td>C</td>
</tr>
<tr>
<td>Sani-Treet Plus</td>
<td>Enzyme Industries (Heath, Ohio)</td>
<td>Line cleaner</td>
<td>Enzyme</td>
<td>60.6 mL to 2,000 mL DI water</td>
<td>4.29</td>
<td>0.23 (0.17)</td>
<td>C</td>
</tr>
<tr>
<td>Lines (Bio-2000)</td>
<td>Micrylium Laboratories (North York, Ontario, Canada)</td>
<td>DUWL cleaner</td>
<td>12% Ethanol, 0.12% chlorhexidine gluconate</td>
<td>No dilution</td>
<td>6.87</td>
<td>0.16 (0.09)</td>
<td>C</td>
</tr>
</tbody>
</table>
## TABLE (CONTINUED)

<table>
<thead>
<tr>
<th>LINE CLEANER/ DISINFECTANT BRAND NAME</th>
<th>MANUFACTURER</th>
<th>INTENDED USE</th>
<th>ACTIVE AGENTS (MANUFACTURER-REPORTED)</th>
<th>LINE CLEANER/ DISINFECTANT PREPARATION</th>
<th>pH</th>
<th>MEAN MERCURY RELEASED ng/mm2* (SD†)</th>
<th>DIFFERENCE BETWEEN PRODUCTS‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prospray</td>
<td>Certol</td>
<td>Disinfectant</td>
<td>0.28% o-phenyl phenol, 0.03% o-benzyl p-chlorophenol</td>
<td>No dilution</td>
<td>9.06</td>
<td>0.15 (0.02)</td>
<td>C</td>
</tr>
<tr>
<td>Stay Clean</td>
<td>Midmark</td>
<td>Line cleaner</td>
<td>10-15% Phosphoric acid, 1-5% glycolic acid, 1-5% isopropyl alcohol</td>
<td>60.6 mL to 2,000 mL DI water</td>
<td>1.86</td>
<td>0.14 (0.02)</td>
<td>C</td>
</tr>
<tr>
<td>VistaClean</td>
<td>Vista Research</td>
<td>DUWL cleaner</td>
<td>Diphenol hydroxy-benzene, USP glycerin</td>
<td>0.09 mL to 500 mL DI water</td>
<td>4.35</td>
<td>0.12 (1.08)</td>
<td>C</td>
</tr>
<tr>
<td>Pure Vac</td>
<td>Sultan Chemists</td>
<td>Line cleaner</td>
<td>10-15% Phosphoric acid, 1-5% glycolic acid</td>
<td>60.6 mL to 2,000 mL DI water</td>
<td>1.81</td>
<td>0.12 (0.02)</td>
<td>C</td>
</tr>
<tr>
<td>Green and Clean</td>
<td>Metasys</td>
<td>Line cleaner</td>
<td>Quaternary ammonium, defoamer, enzymes</td>
<td>19.8 mL to 2,000 mL DI water</td>
<td>5.63</td>
<td>0.11 (0.04)</td>
<td>C</td>
</tr>
<tr>
<td>Cidex</td>
<td>Advanced Sterilization Products</td>
<td>Disinfectant</td>
<td>2.4% Glutaraldehyde</td>
<td>Activator added to 3.785 L of Cidex</td>
<td>8.00</td>
<td>0.10 (0.06)</td>
<td>C</td>
</tr>
<tr>
<td>Iodofive</td>
<td>Certol</td>
<td>Disinfectant/ cleaner</td>
<td>1.75% Iodine, 21.34% phosphoric acid</td>
<td>2.4 mL to 500 mL DI water</td>
<td>2.24</td>
<td>0.09 (2.02)</td>
<td>C</td>
</tr>
<tr>
<td>Zerosil</td>
<td>National Surtex</td>
<td>DUWL cleaner</td>
<td>7.5% Hydrogen peroxide</td>
<td>134.8 mL to 500 mL DI water</td>
<td>2.56</td>
<td>0.08 (3.42)</td>
<td>C</td>
</tr>
<tr>
<td>Fresh-Vac</td>
<td>Ecolab</td>
<td>Line cleaner</td>
<td>Protease enzyme</td>
<td>62.5 mL to 2,000 mL DI water</td>
<td>5.93</td>
<td>0.07 (0.02)</td>
<td>C</td>
</tr>
<tr>
<td>Mint-A-Kleen</td>
<td>Anodia Systems</td>
<td>DUWL cleaner</td>
<td>8.5% Ethanol, 0.12% chlorhexidine gluconate</td>
<td>No dilution</td>
<td>4.99</td>
<td>0.03 (0.04)</td>
<td>C</td>
</tr>
<tr>
<td>Ecotru</td>
<td>Envirosystems</td>
<td>Disinfectant/ cleaner</td>
<td>0.20% Parachlorometaxylenol</td>
<td>No dilution</td>
<td>8.72</td>
<td>0.03 (0.64)</td>
<td>C</td>
</tr>
<tr>
<td>ZPC-11</td>
<td>Sultan Chemists</td>
<td>Line cleaner</td>
<td>Quaternary ammonium chloride</td>
<td>15.2 mL to 500 mL DI water</td>
<td>9.20</td>
<td>0.01 (0.01)</td>
<td>C</td>
</tr>
<tr>
<td>Multicide Ultra</td>
<td>Biotrol</td>
<td>Disinfectant/ cleaner</td>
<td>9.09% o-phenylphenol, 7.66% p-tertiary amyl phenol</td>
<td>3.9 mL to 500 mL DI water</td>
<td>10.26</td>
<td>0.00 (0.02)</td>
<td>C</td>
</tr>
<tr>
<td>Sporicidin</td>
<td>Sporicidin</td>
<td>Disinfectant</td>
<td>2.01% Phenol, 0.01% sodium phenate</td>
<td>42.7 mL activator added to 0.9037 L of Sporicidin</td>
<td>7.45</td>
<td>0.00 (0.09)</td>
<td>C</td>
</tr>
<tr>
<td>ProhenePlus</td>
<td>Certol</td>
<td>Disinfectant/ cleaner</td>
<td>9% o-phenyl phenol, 1% o-benzyl p-chlorophenol</td>
<td>15.6 mL to 500 mL DI water</td>
<td>9.63</td>
<td>0.00 (0.06)</td>
<td>C</td>
</tr>
<tr>
<td>DRNA Vac</td>
<td>Dental Recycling North America</td>
<td>Line cleaner</td>
<td>Nonionic alkoxylate</td>
<td>666.6 mL to 2,000 mL DI water</td>
<td>9.11</td>
<td>0.00 (0.00)</td>
<td>C</td>
</tr>
<tr>
<td>Biocide</td>
<td>Biotrol</td>
<td>Line cleaner</td>
<td>75% Phosphoric acid, iodine</td>
<td>No</td>
<td>2.37</td>
<td>0.00 (0.00)</td>
<td>C</td>
</tr>
</tbody>
</table>
hypochlorite as the active ingredient; the other
three contained sodium dichloroisocyanate, ethyl-
enediaminetetraacetic acid (EDTA), or hydrogen
peroxide and peracetic acid as active ingredients.
The results we obtained with sodium hypochlorite
and sodium dichloroisocyanate preparations
agree with those of previously reported studies. However, the results for the preparation that con-
tained hydrogen peroxide and peracetic acid as
active ingredients differed from those obtained by
Roberts and colleagues. Those authors found no
significant difference in mercury release with the
hydrogen peroxide/peracetic acid preparations or
distilled water. Interestingly, in our study, a
preparation based on hydrogen peroxide without
peracetic acid did not release significantly more
mercury from amalgam than did deionized water.
The results of our study also differ from those
reported by Rotstein and colleagues. Those authors found no
significant difference in mercury release from the
amalgam cylinders to provide a consistent surface area
to react with the chemical preparations. Our
approach differed from that of other studies that
used ground amalgam particles. Even when the
researchers in the other studies controlled par-
ticle size by sieving, the surface areas of each
batch could have varied more substantially than
would be the case with standardized amalgam
cylinders, the surface area of which can be deter-
dined easily. Standardized cylinders, which other
studies have featured, also provided a more
controlled comparison of mercury release from the
preparations.

The reaction kinetics between the preparations
and the amalgam cylinders influences the amount
of mercury released in a specified contact time. It
is important to use the same contact time and the
same surface for all preparations, because it pro-
vides a controlled basis for comparing the amount
of mercury released from the amalgam cylinders.
For all preparations in this study, we used a con-
tact time of 24 hours and a surface area of 113.10
mm². The results of our report can be compared
more easily with those of Kummerer and col-
leagues, who used a contact time of 18 hours for
their study. In contrast, Roberts and colleagues
used contact times based on hydrogen peroxide
preparations or sodium dichloroisocyanate preparations.

Disinfectants or line cleaners that contained
phenols, glutaraldehyde or quaternary ammo-
nium compounds did not release more mercury
from amalgam than did deionized water, a
finding noted in other studies. In our study, we used standardized amalgam
cylinders of consis-
tent surface area and a uniform contact time of 24
hours. The differences in contact times between
the studies and the surface areas of amalgam
samples may explain the observed differences in
the relative amount of mercury released from
amalgam.

Our results showed that pH is not a good pre-
dictor (correlation coefficient [r²] = 0.0236) of mer-
cury release from amalgam; the six preparations
that released more mercury from amalgam than
deionized water were either highly acidic (pH
1.76-2.59) or highly alkaline (pH 10.72-2.35). However, some preparations had similar acidity
levels (for example, pH 1.8) or alkalinity (for
example, pH 11.4) that did not release signifi-
cantly more mercury from amalgam than did
deionized water. Soh and colleagues reported
that a citric acid buffer at pH 2.5 released more
mercury from amalgam than did a citric acid
buffer at pH 7.0. Although the components of the
buffers were mostly identical, the relative
amounts of components used to achieve the dif-
f erent pH values differed between the two buffers.
Thus, our study did not address the more complex
differences in chemical composition of the disin-
fectants or line cleaners.

Our study suggested that the chemical com-
positions of some disinfectants or line cleaners pri-
marily caused the release of mercury from
amalgam. The intended use of each product deter-
mined its active ingredients (Table), according to
manufacturers’ information. However, the list of
active ingredients may not identify chemicals
that are not active in disinfection or line cleaning,
but these chemicals may contribute to the reac-
tion kinetics and influence the type of reaction
products. This may explain why our study results
differ from those of Rotstein and colleagues.

The aim of our study was to compare the effect
of disinfectants and line cleaners on mercury release from amalgam in a highly controlled condition by using the same surface area for the amalgam samples. The heterogeneous nature of amalgam particles in clinical wastewater makes it difficult to quantify the release of mercury. Thus the use of clinical wastewater would introduce a hard-to-control factor into a comparison of the effect of disinfectants and line cleaners on mercury release from amalgam. Therefore, in our study, we used amalgam cylinders of consistent surface area and a uniform contact time of 24 hours.

CONCLUSION

This study and other published reports have demonstrated that preparations containing chlorine release more mercury from amalgam than some other products and the deionized water control. As a result, the use of these products is not recommended for treating dental office waste lines or DUWLs.10