PURPOSE

The purpose of this study was to determine if conventional consumer-purchased pressure cookers can effectively sterilize dental instruments in field dental settings.

BACKGROUND

There is little evidence in the literature about sterilizing instruments in remote areas using a pressure cooker. It seems logical that steam pressurization in the chamber would result in high temperatures which if applied to instruments for enough time, would result in sterilization and kill all microorganisms.5 The dental profession has engaged in humanitarian trips providing dentistry to underserved populations for decades. Dental education also participates in these trips, providing experiential practice for students. Dental care should always comply with accepted professional standards and ethics. Among these standards are complete sterilization of all instruments used, and cross contamination considerations. The American Dental Association states, “All critical and semi-critical dental instruments that are heat stable should be sterilized after each use by steam under pressure (autoclaving), dry heat, or chemical vapor.”3 People who receive dental and medical care are at risk of surgical infections in developing world hospitals ranges from 5% - 20%.4 Surgical infections are the most frequent adverse event affecting patient safety world-wide.5-7

MATERIALS AND METHODS

Four pressure cooker brands were selected based on nine specific criteria deemed desirable for people who travel long distances to provide dental services to remote and rural areas. Sterilization characteristics were tested using spore strips, chemical sterilization indicating strips, instruments, and time variables. To ensure consistency for data collection, parameters were established and implemented, including identical restorative hand instruments contained in an instrument case. The amount of water used for each trial was identical. This amount was selected so that it did not submerge any of the instruments in the holding tray but was more than the water of water that turned to steam and escaped the pressurized system over a 45-minute period of time. Each pressure cooker had a different manufacturer-rated pressure safety-blown-off valve. A graph was plotted showing the increase in pressure vs. time to allowed to elapse time. This established the amount of time needed to achieve maximum pressure. The ability of the pressure cooker to maintain maximum pressure allowed the investigators to determine sterilization effectiveness which was confirmed by sterilization indicators. These values are desirable for people who travel long distances to provide dental services.

RESULTS

Though the pressure cookers exhibited a wide range of maximum pressures, and varying abilities to hold those pressures, we confirmed that sterilization of dental instruments was practical using a conventional pressure cooker. Each pressure cooker was advertised to achieve a maximum pressure of 15 psi, there was an actual range of 12 psi to 17 psi. The success of each unit for sterilization was dependent on the ability of the pressure cooker to seal when temperature increased slowly. With a cooler heat source, although the temperature reached a level required to produce steam, the internal pressure apparently escaped past the rubber gasket so the internal pressure never reached the point of engaging the safety valve. We postulate this may have been caused by minor distortion of the lid when the pressure gauges were mounted. In the first trials using the electric heating source, only two pressure cookers achieved a steady maximum pressure (16 psi and 13.5 psi), which yielded times of sterilization of 15 minutes and 40 minutes respectively. When the gas source was used, all four pressure cookers were able to achieve a consistent maximum pressure (Table 2).

Four pressure cookers were tested (Table 1)

#1. China: 8 quart model (item #91803077), low pressure setting of 8 psi and high pressure setting of 15 psi.

#2. Germany: 8.5 quart model (US Design Patent # D646165 S, Article # 600-700-08-079-0), low pressure setting of 8 psi and high pressure setting of 15 psi.

#3. Switzerland: 8.0 liter model (EN 12778, ISO 9001/ EN 29001, 97/23/EG [Module B]), low pressure setting of 6 psi, and high pressure setting of 12 psi, and a max operating pressure of 17 psi.

#4. Germany: 8.5 liter model (item # 0793149300), low cooking temperature 226 F, high cooking temp 239 F, low pressure setting N/A, and high pressure setting of 15 psi.

Table 1: Pressure Cookers, Size and Pressure Ratings

<table>
<thead>
<tr>
<th>Pressure cooker Number/Country</th>
<th>Model #</th>
<th>Size</th>
<th>Selective Low &amp; High Operating Pressure Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1. China</td>
<td>Fagor Duo #91803077</td>
<td>8 Quarts</td>
<td>Low: 8 psi, High: 15 psi</td>
</tr>
<tr>
<td>#2. Germany</td>
<td>Fissler Vitagg #FPS155859</td>
<td>8.5 Quarts</td>
<td>Low: 8 psi, High: 15 psi</td>
</tr>
<tr>
<td>#3. Switzerland</td>
<td>Kuhn Rikon Dromatic Inox #3044</td>
<td>8 Liters</td>
<td>Low: 6 psi, High: 12 psi, Max operating pressure: 17 psi</td>
</tr>
<tr>
<td>#4. Germany</td>
<td>WMF #709149300</td>
<td>8.5 Liters</td>
<td>Low: N/A, High: 15 psi</td>
</tr>
</tbody>
</table>

Table 2: Sterilization Parameters for Each of the Pressure Cookers

<table>
<thead>
<tr>
<th>Pressure cooker Number/Country</th>
<th>Maximum Pressures (psi)</th>
<th>Time for Sterilization (mins)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1. China</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>#2. Germany</td>
<td>12</td>
<td>26</td>
</tr>
<tr>
<td>#3. Switzerland</td>
<td>15</td>
<td>27</td>
</tr>
<tr>
<td>#4. Germany</td>
<td>8</td>
<td>65</td>
</tr>
</tbody>
</table>

Table 3: Pressure Cookers Maximum Pressures and Times to Sterilization

CONCLUSIONS

This study demonstrated it is possible to effectively achieve sterilization of dental instruments in remote areas by using a conventional pressure cooker. Doing so is a realistic and practical solution to the difficulty of sterilizing dental instruments in remote and rural areas. We anticipate dental educational field trips will continue to provide service to underserved rural populations, as dental outreach provides an educationally valuable opportunity to make a significant contribution and improve oral health in vulnerable communities. Ethical and quality considerations must guide practice standards. Essential among these standards are complete sterilization of all instruments used, and cross contamination considerations. By following these procedures, clinicians can provide safe dental and medical services to patients in underserved areas and do so using accepted standards of sterilization.

Recommended Guidelines to use Pressure Cookers in Remote Settings for Sterilization:

1. Every pressure should be treated prior to field use.
2. Testing should replicate, to the extent possible, the conditions of the remote location.
3. Routine use of chemical sterilization indicator strips during field use is recommended.
4. Instruments should not be covered with water and all surfaces should be exposed to steam.

REFERENCES


3. Routine use of chemical sterilization indicator strips during field use is recommended.

4. Instruments should not be covered with water and all surfaces should be exposed to steam.

5. Instruments should not be covered with water and all surfaces should be exposed to steam.

6. Instruments should not be covered with water and all surfaces should be exposed to steam.


