Providing Developing Countries with Medical Sterilizer Boilers

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A partnership with Christian Hospitals Overseas Secure Equipment Needs (CHOSEN) has led to the improved design of medical equipment sterilizers being used in developing nations. CHOSEN's goal is to refurbish outdated medical equipment, including autoclaves, which are sterilizers that use steam to clean medical tools, and ship them to developing countries to be used in hospitals.

Standard sterilizers use electricity provided by a 120 or 240-volt source. Due to a lack of reliable electricity in developing countries, the boilers must be able to generate steam using non-electrical heat sources, which could include propane, wood, or charcoal. CHOSEN has found that their boilers operate most efficiently when half-filled with water and half-filled with steam, and when approximately 90 psi of pressure is maintained within the tank. Currently to maintain this pressure, an operator has to watch over the boiler for the entire sterilization cycle, which can last up to 2 hours. The operator must manually open and close a bleed valve if the pressure needs to be raised or lowered. An electrical water pump is available to refill the tank when needed, but this also requires the operator to check the water level and manually turn the pump on.

The proposed solution is to use an Arduino Uno, a brand of programmable microcontroller, connected to a pair of water-sensing probes to control the pump which refills the tank as required. An adjustable pressure relief valve maintains the appropriate pressure. The idea is that two water-sensing probes will be mounted inside the tank, one at low water level, and one at high water level. When the lower probe no longer senses water, it will send a signal to the Arduino, which will in turn send a signal to the water pump to turn on. Once the water level reaches the high level probe, another signal will be sent to turn the pump off. The pump motor will be controlled by a solid state high-voltage relay, which will be protected by a circuit breaker to prevent current overload in the event of pump seizure. In the case of relay failure, the pump can be turned on manually via a toggle switch; in case of an emergency, the pump can be turned off via the circuit breaker. To maintain pressure, the tank will be fitted with two pressure relief valves. One valve will be spring-loaded to open and close while maintaining the pressure at approximately 90 psi, while the other will be set to open at 120 psi as an emergency safety measure. The addition of the probes, Arduino, and pressure relief valves offers a simple solution that will allow the autoclaves to use a variety of heat sources to run a full sterilization cycle with little to no operator involvement.