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When Disaster Strikes, Can You Process X-Rays?

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Abstract

In 1994, when a 6.7 magnitude earthquake hit Northridge, California, hospital radiology departments learned an important lesson. Despite having electric generators to provide power to the hospital, without running water these radiology departments could not process x-rays. Members of these departments called upon the expertise of two California businessmen who operated a company called C&A X-ray.

These gentlemen devised a way to process x-rays using 15 gallons of bottled water. Creating a prototype of what would become a product called the Water Saver/Plus™, hospitals crippled by the Northridge earthquake were able to process x-rays for several weeks on bottled water.

In the quiet of the earthquake's aftermath, the two businessmen realized that the Water Saver/Plus™ could be used on a daily basis to reduce the amount of water hospitals needed to process x-rays.

This qualitative study recounts the events that led to the creation of the Water Saver/Plus™ and how the product has been subsequently used to reduce water consumption in drought-stricken California.

INTRODUCTION

The events of September 11th, and the continual terrorism alerts that have followed, have caused hospitals and emergency rescue teams to re-evaluate disaster services. Something area administrators and health care providers may overlook is how to process x-rays when a facility has no running water. Such was the situation faced by several hospitals during the 1994 Northridge earthquake.

METHODS

This historical recounting of events will demonstrate the need for radiology departments, and those who provide rescue and disaster services, to make contingency plans for processing x-rays in situations where running water has been cut off either due to water main breaks, or due to a lack of electricity to pump water to various sites.

A secondary analysis of a new product designed to perform under these emergency situations will reveal that hospital radiology departments can use the equipment in non-emergency settings to save on water and sewer costs.

Hospital processors were first metered for a week to determine the amount of water being used to cool the developer and rinse x-rays. In some cases, while the rated water use for a processor was 2.5 gallons a minute, for example, metering showed that some machines were using 5 gallons a water a minute.

Once the initial metering was completed, a California based company-- C&A X-ray, sometimes in cooperation with the local water authority, installed a Water Saver/Plus™ on the processor.

Again the processor was metered, this time to determine the amount of water being consumed with the new machinery.

STATISTICS

Statistics in this case will show before and after water usage measurements on the more commonly used, large-sized, x-ray processors.

HISTORICAL BACKGROUND

At 4:31 a.m., on January 17, 1994, an earthquake measuring 6.7 rumbled across the San Fernando valley, shaking California residents from their slumber. While the earthquake lasted only seconds, the result was, according to Federal Emergency Management Agency (FEMA), "the largest and most costly disaster to which FEMA has responded." The Northridge earthquake disaster may, however, be eclipsed by the destruction caused on September 11th.

By FEMA calculations, 114,000 residential and commercial structures sustained damage. Seventy-two people perished, and thousands more sought treatment at area hospitals. Since the earthquake hit on a Monday holiday, and in the wee hours of the morning, experts readily admit the number of resulting injuries were limited in scope and number.

A report written by DIS, Inc., an engineering company specializing in earthquakes and buildings, noted nine hospitals in the area of that quake could not provide medical care. Water mains were broken. Electricity was scarce. People sought medical attention for a variety of injuries, including lacerations and concussions. But some people also needed x-rays. Broken water mains and a lack of electricity to pump water from stations to users presented a challenge to radiology departments across the valley.

Hospital generators provided the electricity needed to power the x-ray machines, but those machines needed water to rinse the films. Administrators in several radiology departments made frantic calls to C & A X-Ray, Inc., a California-based company, asking for help. Could C & A X-Ray help these hospitals run x-ray processors without running water?

When posed with that challenge, Dave Crowe and Ken Wrye, co-owners of C & A X-Ray, set about trying to devise an answer. Their ingenuity and understanding of the x-ray developing process led them to create a product the company calls the Water Saver/Plus™. With this product attached to the x-ray processor, films can be rinsed using 15 gallons of bottled water.

Figure 1

Figure 2

RESULTS

Most large hospitals have a number of x-ray processors. "There were five hospitals in need" after the Northridge, California earthquake, said Crowe, "and each had an average of five processors to run." Crowe delivered the Water Saver prototypes to the hospitals his company serviced. With the early versions of the Water Saver/Plus™ in place, Crowe said "two of the hospitals ran their processors for two weeks, several ran longer."

Radiologists and x-ray technicians worried that using the same small amount of water to rinse x-rays, would diminish the archival quality of the film. However, the process devised by Crowe and Wrye did not affect the quality of the film coming from the processors. The company has also performed extensive tests for hypo retention and has found no problems.

At its inception, Crowe said he thought the Water Saver/Plus™ would become an emergency tool that every hospital would have on hand in case of a disaster. But in the calm of the earthquake aftermath, Crowe began to think on a larger level about his new product. If hospitals could run processors on 15 gallons of water during an emergency, what kind of savings could hospitals see during non-emergency situations?

“Many large hospitals run their large x-ray processors 24-hours a day, seven days a week,” said Crowe. Indeed these processors have stand-by modes, but if the hospital is busy, machines often don't get to idle. And often times, through continual use, the processors have faulty solenoids. Those damaged solenoids will allow water to flow down the drain.

So C & A decided to see just how much water could be conserved over the course of a year, should a hospital decide to install a Water Saver/Plus™. The numbers were sobering.

What follows are the results for processors at Good Samaritan Hospital in Los Angeles, California hospital. The metered results were conducted by Mark Gentili, Project Coordinator for Water Conservation Programs for the Department of Water and Power in Los Angeles (LADWP). Good Samaritan was the first hospital to take part in an incentive-based water conservation program offered by LADWP.

“Good Samaritan had a total of 14 x-ray processors,” said Gentili. “Nine of those processors were rated to use 2.5 gallons a minute,” but five of those nine machines were actually using 5 gallons of water a minute, said Gentili who measured the water flow of the machines. Gentili also noted that even when some of Good Samaritan's x-ray processors were turned off, the water would still run through the machines due to an open valve.

Under the conservation program, the City of Los Angeles provided an incentive to Good Samaritan to pay for the Water Saver/Plus™. The unit retails for $4195.

Good Samaritan received a $26,678 rebate from the City of Los Angeles Department of Water and Power. Gentili estimated that the hospital's actual cost was about an additional $10,000. But, noted Gentili, “Good Samaritan is saving over $60,000 a year now in water costs. The hospital recouped its investment in two months.”

The Greater El Monte Hospital in South El Monte, California, realized a savings of 31,000 gallons of water on one processor in one week. A unit of water is equal to 748 gallons, and in California, the cost of water is $2/ per water unit. Sewer costs are also $2/water unit. So, the savings adds up to $4 per water unit.

Using the El Monte numbers, the hospital could save approximately $164 a week. That savings may seem small, however, over the course of a year, that translates to more than $8,528 for one processor. If a hospital is running five processors, for example, that savings translates to more than $42,000.

“Depending on the type of x-ray processor and its use,” said Gentili, “the Water Saver/Plus™ can potentially cut water usage by an x-ray processor by 97-98 percent.”

DISCUSSION

If the hospitals in the San Fernando Valley were in dire need of x-ray processors to tend to casualties from an early morning earthquake, where casualties were admittedly light, what will hospitals need should the daily terrorism alerts and the dire predictions of impending doom become reality? Among many needed provisions, having an operating x-ray processor, with a Water Saver/Plus™ attached, may prove critical.

“Most hospitals have contingency plans,” said inventor Crowe, “and every hospital should have at least one x-ray machine up and running.” Even if the water mains remain intact during a crisis, noted Crowe, the water companies need electricity to pump water to customers. No electricity still results in no water, even if a hospital has an emergency generator. Hospitals in the wake of the Northridge quake learned this lesson while scrambling to provide care.

If there is a downside to the Water Saver/Plus™ it is the reluctance of hospital administrators to invest in a piece of equipment. Hospitals are used to getting machines for free, but as Gentili pointed out, if the hospitals realized how much money in water costs go down the drain daily, administrators would think differently.

Crowe says he often hears administrators say that digital x-

rays are just around the corner. However, Crowe thinks truly reliable digital equipment is at least five years away. And, of course, with the potential for disaster closer than ever before, radiology departments need to consider this device for emergency situations.

Gentili, from the LADWP said that hospitals wavering about purchasing this piece of equipment should meter their x-ray processors prior to purchase and installation to determine just how much water is being used by an x-ray processor. In his experience, many processors often use more water than they are rated to use. And, even if a processor only consumes its rated amount of water, hospitals can see a dollar savings with the Water Saver/Plus™.

For example, one of the most common hospital x-ray processor uses 2.5 gallons of water per minute. Consequently, after an hour, the processor can potentially consume 150 gallons of water. In a 24-hour period, water usage for that processor could reach 3,600 gallons of water. In a year's time, that processor could potentially consume more than a million gallons of water.

Installing the Water Saver/Plus™ potentially reduces the water consumption to 16,000 gallons a year. This gallon projection includes the 15 gallons of water needed every two weeks to clean the processor.

ACKNOWLEDGMENTS

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