US Depends on Foreign Supply of Life-Saving Medicine

My mom's cardiologist recently ordered a cardiac nuclear stress test for her heart after an illness resulted in congestive diastolic heart failure. A nuclear stress test measures blood flow to your heart at rest and while your heart is working harder due to exertion or medication. The test provides images that can show areas of low blood flow through the heart and damaged heart muscle. The nuclear medicine used in cardiac nuclear stress tests is Technetium 99m (Tc-99m). Nuclear medicine is a life-saving tool used by doctors to diagnose disease or other conditions. Did you know that currently there is no domestic supply of the most commonly used nuclear medicine? The United States (US) is completely dependent on foreign sources for the supply of Tc-99m and other medical nuclear isotopes. Medical isotopes are an important life-saving tool used by doctors and efforts are underway to restore a domestic supply.

Nuclear medicine uses small amounts of radioactive isotopes to diagnose and care for many different diseases. Doctors use these medical isotopes by putting them into the patients' blood stream to detect if the heart is pumping blood properly, if cancer has spread to patients' bones and to diagnose gallbladder, kidney and brain disorders. Several radioactive isotopes are used in nuclear medicine. Technitium-99m (Tc-99m) is most commonly used in heart and skeleton imaging but is also used in imaging of the liver, gallbladder, thyroid, brain, lungs, spleen and bone marrow. Chromium-51 is used in labeling red blood cells and counting of gastro-intestinal protein loss. Copper-64 is used to study genetic diseases affecting copper metabolism; Iron-59 studies iron metabolism in the spleen. Phosphorus-32 is used in treating excess blood cells. Sodium-24 is used to study electrolytes in the body.

Eighty five percent of all medical scans use Technetium-99m. Tc-99m is used in approximately 76,000 scans per day or 20 million doses per year. Over half of the medical scans using Tc-99m are performed in the US. Tc-99m emits gamma rays and low energy electrons, but the radiation dose to the patient is minimized since the low energy gamma rays easily escape the human body. Tc-99m has a half-life of six hours, which means that Tc-99m cannot be stored and must quickly be distributed and used. Scans using Tc-99m are performed with a small quantity of the isotope that emits low energy gamma rays which is detected by a gamma camera. Tc-99m is produced from its parent isotope, Molybdenum-99 (Mo-99) which has a half-life of 66 hours, and is separated using a medically approved generator to provide Tc-99m for the nuclear medicine procedure.

The World Nuclear Association reports that Mo-99, the parent isotope of Tc-99m, is produced in only five reactors world-wide – Canada, Netherlands, Belgium, France and South Africa. The reactors in Canada and the Netherlands supply about seventy percent of the world's medical isotopes. All five of these reactors are over 30 years old and two of the five reactors are over 50 years old. The age of these reactors are causing periods when at least one reactor is unable to produce Mo-99 for months. In fact, the reactor in Canada was shut down in October 2016, putting a burden on the production of Mo-99 to other operating reactors. In 2009-2010, a shortage of Mo-99 was caused by the unexpected shut down of two reactors in Canada and the Netherlands. The American Chemical Society states that a global shortage of these life-saving materials that could interfere with the ability to adequately treat patients and increase health care costs.

There have been many plans to counteract the aging reactors; some plans include building multiple new reactors in Canada and Australia. The US Department of Energy is supporting the American Medical Isotope Production Act (AMIPA) which was enacted on

January 2, 2013, and is intended to help establish a reliable domestic supply of Mo-99 produced without the use of Highly Enriched Uranium (HEU). HEU is most commonly used in reactors to make medical isotopes – about 75% of the world's supply of Mo-99 is produced using targets containing uranium enriched to greater than 90% uranium-235. Most of this HEU is of US origin. The AMIPA promotes the use of Low Enriched Uranium (LEU) instead of the commonly used HEU. HEU is used to produce bomb materials that is highly explosive and dangerous. The US is leading the effort to discontinue the use of HEU to reduce the global threat of nuclear weapon production. Some US companies are proposing new ways to produce Mo-99 using LEU, and are supported by the US government under AMIPA. For example, there has been a proposal to irradiate Mo-98 with neutrons from power generating reactors to create Mo-99. Another new company, SHINE Medical Technologies, has proposed using a solution reactor with generating neutrons from an accelerator at subcritical level meaning the reactor stops when the accelerator is turned off. These new methods for producing Mo-99 to make the Tc-99m used in nuclear medicine still won't be available for a few more years.

All of the major reactors that produce medical isotopes are now located outside of North America with the recent shutdown of the Canadian reactor, causing the US to rely on foreign supply of these medical isotopes to treat the millions of patients that require these life-saving diagnostics and treatments. The US produces less than five percent of the world's share of medical isotopes. At one time, research and test reactors at U.S. national laboratories and universities provided enough Mo-99 to satisfy domestic demand. When demand outstripped supply, private industry stepped in to both produce and distribute Mo-99. US commercial medical isotope production facilities were forced to shut down in the 1990's due to contamination concerns and the industry was unwilling to assume the risks associated with building new reactors. Russia entered the market of producing isotopes and the US has not been able to re-enter the market. The US nuclear medicine market cannot currently compete against the cheap prices of long-term foreign supply contracts providing health care companies with these medical isotopes. These foreign companies can create monopolies focusing on a certain isotope that results in higher prices and unreliable services, impacting health care in the US.

The United States is very much dependent on foreign suppliers to supply life-saving medical isotopes. These life-saving isotopes include Tc-99m (from Mo-99) which is used for heart scans and cancer treatments. Fortunately, there are signs of progress towards developing domestic manufacturers of these life-saving tools in the US. A domestic source of Mo-99 and Tc-99m and other medical isotopes will ensure that doctors won't have to delay or cancel important nuclear medicine diagnostic testing if there is an interruption in foreign supply. Nuclear medicine is an important life-saving diagnostic tool and a domestic supply of these medical isotopes is needed to ensure that they are available in the US when needed. By the way, my mom's doctor says that the cardiac nuclear stress test shows that her heart has recovered from her illness and is back to normal.

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