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From a young age, most people despise making visits to see their local doctor. Doctors are responsible for the painful vaccinations that one must receive periodically in order to attend primary school. However, most of us fail to recognize the significance of all of the precautionary tests and screenings that a patient may occasionally endure. If one breaks his or her leg, the process of taking a picture using an x-ray to aid the doctor in determining the next steps in repairing the broken limb is almost effortless. Like the x-ray, nuclear medicine is used to detect certain diseases in the body in earlier stages in order to help the patient be properly diagnosed in the shortest amount of time. Unfortunately, the process in which nuclear medicine is made readily available to hospitals is extremely delicate and can be hindered very easily.

First, in order to truly understand the importance of a sufficient isotope supply for nuclear medicine, one must understand what nuclear medicine is. According to the American Board of Nuclear Medicine (2014), nuclear medicine is defined as "the medical specialty that uses the tracer principle, most often with radiopharmaceuticals, to evaluate molecular, metabolic, physiologic and pathologic conditions of the body for the purposes of diagnosis, therapy and research" (The American Board of Nuclear Medicine, 2014, para.1). In simpler terms, nuclear medicine uses isotopes in order to take molecular images of the internal body in order to help treat a patient, or aid in the research of a scientist. Nuclear medicine uses a particular element called Molybdenum-99 (Mo-99) that is a fission product of the Uranium-235 isotope. When Mo-99 decays it produces Technetium (Tc-99m). According to the European Nuclear Society (ENS), "Tc-99m is used in about 80% of all diagnostic imaging procedures" (European Nuclear Society, Introduction, para. 3). In the world, there are only five plants that possess the reactors needed in order produce this particular isotope: National Research Universal (NRU) reactor in Chalk River, Canada; High Flux Reactor (HFC) in Petten, The Netherlands; Belgian Reactor 2 (MR2) in Mol, Belgium; OSIRIS in Saclay, France and the South Africa Fundamental Atomic Research (SAFARI) reactor in Pelindaba, South Africa (European Nuclear Society, Production and Separation Facilities, para. 1). If one of these reactors were to break down, the isotope supply for nuclear medicine would be greatly reduced and would lead to a nuclear medicinal crisis. Since Mo-99 has a half-life of sixty-six hours and Tc-99m has a half-life of six hours, both isotopes, once extracted, must be immediately shipped to hospitals. Due to their short life, neither isotope can be stored for later use. Hospitals rely on weekly shipments in order to take molecular images and diagnose patients. Therefore, if there were to be a shortage in the isotope supply, hospitals would be instantaneously affected.

In 2009, the NRU reactor in Canada and the HFR in the Netherlands both shut down due to a heavy-water leak and a month-long inspection, respectively. Paula Gould states, “Together, the reactors produce two-thirds of the global supply of molybdenum-99, which decays to form technetium-99m, an isotope that is used in about 70,000 medical imaging procedures worldwide every day” (Gould, 2009, para.3). All five reactors were at least 40 years old and were starting to wear down. Scientists around the world were pressed to come up with different ideas on how to restore the rest of the missing isotope supply while the two reactors were out of action. The world then realized that not only was the isotope supply fragile, but also that there were not enough reactors in the world helping to produce it. Multiple countries scrambled to open new reactors for production in hope that they could also replace the old reactors that were, slowly but surely, breaking down.

One might wonder why a crisis that happened almost five years ago has anything to do with the current times. Unfortunately, despite efforts to supply more reactors around the world, the same five ageing reactors are being to this day to supply the world's isotopic supply. Luckily, the crisis in 2009 has forced governments around the world to increase the number of reactors capable of producing Mo-99. However, the world has still experienced multiple shortages since 2009. On November 2, 2013, the SAFARI reactor in South Africa was closed down due to a rare "chemical reaction between cleaning materials used in preparation for a new production run" (World Nuclear News, 2013, para. 1). Six days later the HFR in the Netherlands was also temporarily closed down due to "concerns over levels of uranium in a liquid waste tank" (World Nuclear News, 2013, para.2). Finally, on November 19, the NRU reactor in Canada was shut down for repairs. Currently, the world relies on many mini-reactors to make-up the missing supply, particularly Australia's OPAL reactor that can "potentially supply half of the world's demand" (World Nuclear News, 2013, para. 5). The World Nuclear News reports that new facilities are still being constructed and are predicted to be open in 2016 (World Nuclear News, 2013, para. 5).

So what exactly happens when the world sees an isotope supply crisis? When Mo-99 cannot be produced (therefore also effecting the Tc-99m supply), research projects are put on hold or even canceled. Hypothetically, if a scientist was on the verge of making a new discovery in nuclear medicine and a crisis hit, that scientist would either have to wait for months on end to confirm his or her results, or completely let go of his or her project completely. Shortages in supply can hurt scientists but they directly affect consumers in hospitals. If doctors are unable to have ready access to Tc-99m, they cannot take molecular images of their patients. This postpones treatment for patients and while time may mean nothing for some, it could very well mean life or death for others. The molecular images provided by Tc-99m help to reveal the chemical biology of a particular disease and personalize treatment to a particular patient (The American Board of Nuclear Medicine, 2014, What Is Molecular Imaging, para. 6). This process differs from x-rays and ultrasounds in that instead of providing anatomical pictures, “molecular imaging allows physicians to see how the body is functioning” (Molecular Imaging, 2014, para. 1). Molecular imaging is the only technique of its kind; it helps prevent procedures like biopsies or surgeries by pinpointing not only where the disease is located in the body but also what stage the disease is at. This technique helps identify diseases such as cancer, heart disease, and disorders in many other parts of the body such as the brain, lungs, and kidney. If patients are cut off from this treatment, many will not be able to be diagnosed. The time that it takes to resume treatment may be enough to allow some diseases to exacerbate. If these diseases are given a chance to do so, treatment can gradually become more and more ineffective.

Individually, one may not be able to simply build a proxy for an ageing reactor in times of need. However, an individual can help educate those around them in the importance of nuclear medicine and having a proper and sufficient isotope supply. Today in society, one only hears about the negatives of nuclear energy (nuclear bombs, nuclear waste and spills, etc); however, not many are truly educated about the positives of nuclear energy (nuclear medicine, alternative resource, etc.). By helping to educate others one can create a society that agrees to help build a new reactor in times of need solely based on the knowledge of the fragility of the supply for nuclear medicine rather than a society that denies construction because “Nuclear energy is bad!” Molecular imaging has treated thousands of people diagnosed with cancer and heart disease along with many other diseases. We may not have the cure to cancer, but we have a pretty exceptional weapon against it. Help protect it.

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