

## MEDICAL DEVICES

### MEDICAL INNOVATION: COMPUTED AXIAL TOMOGRAPHY (CAT) SCAN (MEDICAL DEVICE: DIAGNOSTIC)

**Engineers: Godfrey Hounsfield, Allan Cormack**

**Industry: EMI Laboratories**

#### **Situation**

##### ***Harnessing computing power and imaging technology together***

Since the development of the x-ray in the early twentieth century, physicians have been able to use body imaging to detect some abnormalities in the body, most particularly broken bones and some chest/lung conditions. However, the two-dimensional images from x-rays proved of little help in diagnosing most tumors, embolisms, blockages and abnormalities in the body, and, as a result, medical decisions were based on very little concrete information other than what could be discovered through invasive procedures such as biopsy and surgery.

With the advent of computing power in the early 1960's, engineers and physicians theorized that a way could be found to harness multiple images taken in a three-dimensional plane, and process the images digitally to give, in effect, a medically-significant view of almost any area of the body that could help in early detection of tumors, blockages, hemorrhages and the like. The theory of so-called Computed Axial Tomography, or CAT-scan technology, though, proved much harder, and much more expensive, to put into practice than originally thought.

#### **Physician-Industry Collaboration**

##### ***Refusing to take "no" for an answer leads to Nobel Prize***

Allan Cormack, a physicist at Tufts University, did some initial research into the physics of three-dimensional imaging and in 1964 came up with a solution of the problem of "line integrals" -- a mathematical technique that is used in most modern CAT-scan computation. Completely separate from Cormack's work, an English engineer named Godfrey Hounsfield at the British recording company EMI, set to work on developing CAT-scan technology using the company's vast resources, and working largely alone.

When he was well along in the development of his technology, Hounsfield approached the radiology department National Neurological Hospital at Queen's Square in London with a proposal to work jointly on the final development and testing of his concept on patients. He was sent away promptly with an admonition to stop wasting people's time with a hopeless technology that had limited clinical usefulness.

Undaunted, Hounsfield approached the chief of neuroradiology at a second large hospital, Atkinson Morley's Hospital (AMH) in Wimbledon, and struck an arrangement to work quietly on perfecting his technology over the ensuing several months. He built a scanner, and the first tests on patients astonished the AMH faculty, who promptly unveiled them to radiologists worldwide. Demand for the scanners was instant, and EMI set to producing them in large quantities to meet a variety of diagnostic applications for hospitals around the world. Subsequently, Hounsfield and Cormack were jointly awarded the [1979 Nobel Prize for Physiology or Medicine](#) for their joint work on bringing CAT-scan technology to life.

## Innovation Benefits

### ***52 million tests each year***

Since its first fielding in the early 1970s, the use of CAT scans in diagnosing various conditions has expanded significantly, and the speed, resolution and patient comfort of the devices have improved dramatically. There are now more than 6,000 CAT-scan machines installed in the U.S. and about 30,000 installed worldwide, performing some 52 million tests each year.

CAT-scan technology offers physicians the ability quickly to diagnose almost all conditions in the body, including brain tumors, colon cancer, lung embolisms, heart blockages, kidney stones and 3-dimensional bone scans for compound fractures.

## Patient Benefits

### ***A cancer detected early***

Ethicon Endo Surgery describes [a powerful testimonial](#) of one mother whose early detection of her cancer transformed her life: At age 45, Janet S. assumed her long hours as a delivery room nurse and her commitments as a mother of four were to blame for her severe fatigue. Looking back, she admits, “I was in denial and had convinced myself I wasn’t sick – that maybe all I needed was a rest.

The truth was Janet had become one of nearly 150,000 Americans who develop colorectal cancer each year.

Janet did a quick blood test and found her hemoglobin was well below the recommended level for average, healthy adults. Janet began taking iron supplements, assuming her low hemoglobin was the cause of her fatigue, all the while keeping it secret from her family.

Several months later, Janet finally saw her primary care physician and was referred for more tests. It wasn’t until Janet’s urologist ordered a CAT scan, that her physicians discovered an advanced-stage cancerous colon tumor. Janet and her doctor decided to follow the course prescribed for most patients in her condition – surgically removing the tumor using a minimally invasive procedure.

Janet was out of the hospital in three days and back on her feet shortly thereafter, following an aggressive course of post-surgical chemotherapy. She was one of the lucky ones whose cancer was detected early. Unfortunately, only 37 percent of colon cancer patients are diagnosed at the local stage before the disease has spread from the colon to surrounding tissues and organs.

A year later, Janet was back to being herself again, and her experience helped her decide on a career change – she has now become an operating room nurse. “I wanted to be a kind face for my patients before and after surgery and be there to hold their hand,” she said. “Everything in your life happens for a reason – this was a gift for me to pay forward.”

