Improved Medical Technology Leads to Better Overall Health

"In countless ways, medical technologies can improve access to care, improve the effectiveness of care, decrease morbidity and mortality, speed up recovery, and increase patient comfort."

In the following viewpoint, two researchers argue that advances in medical technology have improved patient care. The authors examine studies that illuminate the improved mortality, shorter hospital stays, and better physician care of those who utilize newer technologies. They conclude that the increasing price of new technology is worthwhile because the increased life expectancy of those who benefit improves society. Nadeem Esmail is the director of the Centre for Health System Performance Studies and manager of the Alberta Policy Research Centre at the Fraser Institute. Dominika Wrona is a Fraser Institute intern and MBA student at the University of Toronto.

Advanced medical technologies can deliver numerous benefits to both patients and those funding the health care system. According to Australia's Productivity Commission, medical technologies "... have reduced disease risk factors, long-term complications of related chronic diseases, and the need for drugs. They have also improved mobility and day-to-day functioning, and reduced hospital admissions, length of stay, and the indirect costs of caring for patient." Further, significant advances in the field of diagnostic equipment, surgical and laboratory procedures, and non-surgical equipment have increased hospital efficiency as well as patient comfort and safety. New medical devices and interventions are also able to offer patients treatments and diagnoses previously unavailable.

For example, newer advanced diagnostic equipment such as multi-slice Computed Tomography (CT) scanners, more powerful Magnetic Resonance Imaging (MRI) machines, and Positron Emission Tomography (PET) scanners (both stand-alone and combination PET/CT units) allow for greater accuracy, speed, and efficiency in diagnosing medical problems. They also provide less invasive procedures for the diagnosis of disease, which can facilitate earlier and more localized treatment. Doctors can use more sophisticated scanners to observe and learn more about the body's functions and location of disease without subjecting the patient to surgery for either diagnosis or needless interventions. For example, a PET scan can detect a lung cancer that has spread, and thus avoid a futile operation. It can also determine if liver tumours can be safely removed, and can help determine if chemotherapy treatment is working, or whether the drug cocktail being provided needs to be changed. PET scanners also allow some patients to avoid surgical biopsies for the diagnosis and identification of cancers.

Improved Surgical Technologies Reduce Trauma and Hospital Stays
Due to innovation in surgical technologies, surgeons are now able to use specialized instruments to reduce the impact of treatment on patients. For example, surgeons today might use a video camera to enter the body through small incisions, and then move the camera lens and their surgical tools through tissue and blood vessels to the affected area, rather than opening the entire body cavity as was once common. Thanks to minimally invasive surgical techniques, procedures that once required patients to stay in hospital for days can now be performed on an outpatient basis. For example, surgical complications, time spent in hospital, and the amount of trauma to the patient have been significantly reduced by replacing conventional cholecystectomy (gall bladder removal) with minimally invasive laparoscopic cholecystectomy.

New laboratory procedures have also played an important role in identifying certain medical conditions, or predispositions to them. Armed with increased knowledge about the potential risks for developing certain conditions or diseases, patients have the impetus to be proactive about those diseases by altering their lifestyles and increasing their surveillance of the condition. For example, laboratory tests can determine mutations in the BRCA1 and BRCA2 genes, which can signal a higher risk of certain cancers like breast cancer or ovarian cancer.

Advances in medical technology can also improve non-surgical hospital services. For example, electronic storage of diagnostic images can increase the efficiency of patient information transfer and ensure faster turnaround times. Electronically stored diagnostic images can also allow for long-distance contracting by reducing or eliminating the need to physically handle and transport images. As another example, automated medication dispensing systems can decrease the incidence of medical errors in drug distribution and can reduce the time pharmacists and nurses spend on drug dispensing.

New medical devices can also offer new treatment options to patients who were previously left untreated. Consider the Implantable Cardioverter Defibrillator (ICD), which works on the same principal as an external defibrillator, but is implanted in a patient's chest. The ICD sends an electrical current to the heart when it detects serious arrhythmia, or a stoppage, in order to restore normal rhythm. This device allows patients at risk of sudden cardiac arrest to live independently and not be under constant surveillance.

**Studies Show a Decline in Heart Patient Mortality**

In countless ways, medical technologies can improve access to care, improve the effectiveness of care, decrease morbidity and mortality, speed up recovery, and increase patient comfort. These benefits are not just theoretical, but have been quantified in published studies.

[Dr. M.G. Myriam] Hunink et al. studied the decline in mortality rates due to coronary heart disease between 1980 and 1990. The authors estimated that 25 percent of the decline could be explained by primary prevention (reduction of coronary heart disease incidence), and 43 percent could be explained by improvements in the treatment of patients with coronary heart disease. That is, improvements in patient treatment between 1980 and 1990 explained almost half of the decline in mortality from coronary heart disease. Eugene Braunwald, a renowned cardiologist and researcher, stated:
Diagnostic imaging of the heart, great vessels, and coronary arteries ... has greatly facilitated cardiac diagnosis. Notable therapeutic advances include the development of open-heart surgery for the treatment of many forms of congenital and acquired heart disease; catheter-based interventions, such as coronary angioplasty and stenting, for the nonsurgical treatment of coronary artery disease; and cardiac pacemakers and implanted cardiac defibrillators for a variety of life-threatening cardiac arrhythmias. These procedures ... have improved the quality and, increasingly, the duration of life.

Braunwald goes on to say that advances in cardiac imaging "will facilitate the early identification of patients at high risk for serious coronary events." He adds that "newly developing catheter-based techniques for coronary revascularization that incorporate new approaches to prevent restenosis [i.e., the closing of an artery that was previously opened by a cardiac procedure] should help to reduce the incidence of acute coronary events."...

**Advancing Medical Technology Improves Neurosurgical Outcomes**

[S.C.] Johnston et al. compared the outcomes of treating unruptured cerebral aneurysms with the common procedure of surgical clipping (performed by neurosurgeons) and the newer, less invasive alternative of endovascular coil embolization (performed by neuroradiologists). The authors found that surgery was associated with greater rates of new disability, an increased likelihood of reporting new symptoms or disability after treatment, more complications, and longer recovery. Surgical patients also experienced longer hospital stays (7.7 days, on average, for surgery compared with 5.0 days for embolization) and higher hospital charges ($38,000, on average, for surgery compared with $33,400 for embolization).

Similarly, [D.H.] Molyneux et al. compared outcomes of treating ruptured intracranial aneurysms with neurosurgical clipping and endovascular coiling in 2,143 patients. The study found that 23.5 percent of patients treated with endovascular coiling were dead or dependent one year after treatment (8.0 percent dead, 2.6 percent fully dependent, 2.8 percent partially dependent, and 10.1 percent with significant restriction in lifestyle) compared to 30.9 percent of patients treated with neurosurgery (9.9 percent, 3.6 percent, 4.0 percent, and 13.4 percent respectively). This difference in survival was statistically significant and persisted for at least 7 years after treatment. The study also found that the risk of epilepsy was substantially lower in patients who received endovascular treatment. Conversely, though the risk of late rebleeding was still low, it was higher than for those treated with neurosurgery.

**Medical Innovation Improves Mortality Rates**

Frank R. Lichtenberg measured the effect of innovation in five areas of medical procedures and products: pathology and laboratory procedures, outpatient prescription drugs, inpatient prescription drugs, surgical procedures, and diagnostic radiology procedures, on the mortality and disability of Americans who were afflicted with a condition whose treatment was affected by innovation between 1990 and 2003. The study found positive and significant correlations between lab innovation and outpatient drug innovation, and mortality. The study also found that conditions with higher rates of laboratory and outpatient drug innovation exhibited greater
increases in the mean age at death. Lichtenberg estimated the increase in the mean age at death resulting from the use of new laboratory procedures to be approximately 6 months, or 42 percent of the total increase (1.18 years), in the mean age at death observed over the period in the sample of diseases. He further estimated that new laboratory procedures introduced between 1990 and 1998 had saved 1.13 million life-years in 1998 (2.31 million people who died in 1998 multiplied by the extra 6 months they lived due to new laboratory procedures).

Medical Technology Advances Lead to Shorter Hospital Stays

A recent [2007] report by the Canadian Institute for Health Information looked at trends in hospital use. It suggested that "advances in medical technology [are] leading to more efficient ways of treating inpatient." The report also found that more operations are being performed as outpatient day surgeries across Canada; the number of hospital procedures performed as outpatient day surgeries increased by 30.6 percent over 10 years, while the number of inpatient surgeries decreased by 16.5 percent. The total number of surgeries increased by 17.3 percent. Further, the age-standardized hospitalization rate decreased by 25 percent over the 10 years, falling from roughly 11 out of 100 Canadians being hospitalized in 1995-1996, to roughly 8 out of every 100 Canadians in 2005-2006. The total number of days Canadians spent in acute care hospitals had also decreased, falling from approximately 23 million days in 1995-1996 to 20 million in 2006 (a 13.1 percent reduction). Moreover, even though the average length of hospital stay remained unchanged since 1995-1996 at 7.2 days, the age-adjusted national average length of hospital stay decreased from 7.5 days in 1995-1996 to 7 days in 2005-2006 (a 6.7 percent decrease). The report made no explicit link between the reduced length of hospital stay, the reduced likelihood of hospitalization, the increased reliance on outpatient day surgery, and advances in medical technology. However, the correlation between advances in medical technology (pharmaceutical, surgical, diagnostic, and otherwise) and shorter hospital stays is worth noting and has been confirmed by studies examining some forms of medical technologies....

Medical Technology Improves Physician Care

[J.] Wang and [D.] Jamison, in a study examining differences in mortality across OECD nations, found that the "availability of medical technology appears to play a significant role in improving the efficiency of health care provided by doctors (to reduce mortality) across countries." More specifically, they found after controlling for factors such as income and the number of physicians, that countries with a higher long-term availability of MRI and CT scanners (used as proxies for technology generally) produce better health outcomes in terms of life expectancy and potential years of life lost to heart disease. In other words, this study suggests that there is an important beneficial relationship between the supply of medical technologies and the impact of physician care.

Advances in Medical Technology Are Worth the Cost
The studies examining the medical benefits of advances in technology discussed above show that advanced medical technologies can reduce mortality, increase longevity, and increase quality of life. However, these new technologies can be expensive and their costs are often cited as reasons for the lack of investment. A common concern is whether the benefits of medical technologies are worth their cost. Several studies address this issue directly.

In the paper measuring the effect of innovation in laboratory procedures discussed above, Frank R. Lichtenberg determined the cost per life-year gained from the new laboratory procedures was estimated to be $6,093. According to Lichtenberg, this value is generally considered to be "quite cost-effective." Similarly, [Dale A.] Rublee, in a review of access to medical technology, states that computerized diagnosis and lithotripsy can be both quality enhancing and cost saving.

[David M.] Cutler and [Mark B.] McClellan reported on a series of studies showing the disease-level costs and benefits of medical advances in five conditions: heart attacks, low birth weight, depression, cataracts, and breast cancer. The study primarily measured increased longevity and increased productivity of patients as a result of the introduction of medical technology. Cutler and McClellan concluded that even though technological change has accounted for a significant portion of medical care cost increases over time, medical spending as a whole is worth the cost....

For example, according to the study, life expectancy for the average person following a heart attack was just short of 5 years in 1984, but by 1998 it had risen to 6 years. Assuming the additional year of life was valued at $100,000 and the annual cost of living was estimated to be $25,000 during that additional year of life, Cutler and McClellan estimated the benefit to society of an additional year of life for heart attack patients to be $75,000. Including an accounting for the time-value of money (a dollar given six years from now is worth less to an individual today than is a dollar given today), the present value of the benefits from technological change was found to be $70,000. Since the treatment costs increased by $10,000 between 1984 and 1998 as a result of technological innovation that both replaced older forms of care and provided existing technologies to more patients, the net benefit from new technology was estimated to be approximately $60,000.

The Cost Outweighs the Benefit

Cutler and McClellan (2001) also reviewed studies examining the costs and benefits of technological change in the treatment of low birth weight infants, depression, cataracts, and breast cancer. They found that the estimated benefit of technological change in all but the latter was much greater than the cost. Though outcomes were improved by advances in the treatment of breast cancer, the increase in costs was roughly equal to the societal benefit, which led to the conclusion that, in this instance, "technological change was neither beneficial nor harmful on net."

The study concluded that the cost of technology for heart attacks, low birth weight, depression and cataracts is high, but it is outweighed by the value of health benefits that accrued from the introduction and use of these technologies. Although only 5 conditions were analyzed in the study, the results have implications for the health care system more broadly. The report states: "The benefits from lower infant mortality and better treatment of heart attacks have been
sufficiently great that they alone are about equal to the entire cost increase for medical care over time. Thus, recognizing that there are other benefits to medical care, we conclude that medical spending as a whole is clearly worth the cost."

A study by Cutler finds that revascularization, or re-establishing adequate blood supply, following a heart attack (including angioplasty and coronary artery bypass grafting) is also a cost-effective technological innovation. Specifically, the study examines the survival and care costs for US Medicare patients over a 17-year period following their heart attacks. Cutler determines that revascularization results in a 1.1 year increase in life expectancy at a cost of approximately $38,000 ($33,246 per year of life gained) if the benefits of revascularization flow directly from the treatment, or a 0.08 year increase in life expectancy at a cost of approximately $1,389 ($17,022 per year of life gained) if admission to a hospital with revascularization capabilities is the source of benefits for patients. Either way, Cutler finds that the care provided is clearly worth the cost, whether the care provided is revascularization itself, or the quality of care provided by hospitals with revascularization capabilities.

**Minimally Invasive Procedures Save Money**

A study commissioned by the Canadian Association of Radiologists and the Canadian Interventional Radiology Association showed that significant savings could be realized if existing surgical procedures were replaced with interventional radiology (minimally invasive procedures performed using image guidance). Specifically, the study found that for 8 diseases, replacing existing surgical procedures with interventional radiology procedures in appropriate circumstances could potentially save 402 Canadian lives annually, as well as 98,010 hospital bed-days, $180.3 million in direct treatment costs, and more than $92.3 million in societal costs.... (These costs include indirect health care savings associated with faster recovery and return to work, and less follow-up visits.) These savings calculations were not net-of-costs; the study estimated that an annual budget of $221.3 million would be required to realize the annual savings....

The evidence reviewed above finds that medical technologies can increase longevity, reduce mortality, and improve quality of life for those fortunate enough to have access to them. Medical technologies can often accomplish these improvements cost effectively, and in some cases can reduce costs while improving outcomes. Thus, a high quality health care program should provide individuals with a high level of access to medical technologies; not doing so would be to the detriment of patients. Does Canada’s health care program live up to the claim that it is a high quality program?

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