



CARDIOVASCULAR INNOVATION INSTITUTE

A partnership between The University of Louisville and Jewish Hospital with support from Kentucky's Office for the New Economy and Sen. Mitch McConnell

The Mission

To develop one of the top cardiovascular research institutes in the world for the testing, clinical evaluation and development of bio-adaptive heart innovations, including heart assist devices, biofeedback sensors and related technologies.

To foster the development of commercial enterprises related to the core competencies of the institute in conjunction with the Kentucky Office for the New Economy.

The Goal

To improve care for desperately ill heart-failure patients and enable them to live longer, better lives at home.

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“I’m Not Done Living”

When 59-year-old Robert Tools was told that he had only 30 days left to live because of advanced heart failure, he decided to travel from his home in Franklin, Ky. to Jewish Hospital in Louisville. He had read in Newsweek magazine about the AbioCor® Implantable Replacement Heart, which was being tested by University of Louisville cardiac surgeons Laman Gray and Rob Dowling in partnership with Jewish Hospital. Talking to the surgeons, Robert Tools said, “I’m not done living.”

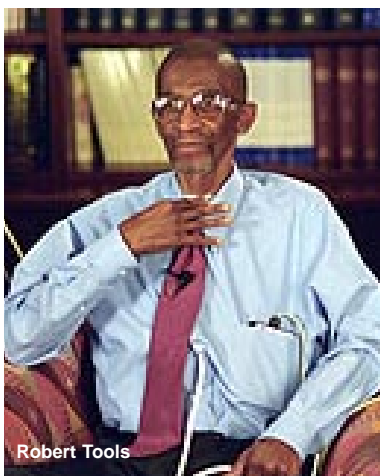
On July 2, 2001, Gray and Dowling implanted the world’s first implantable replacement heart into Robert Tools in a landmark surgery at Jewish Hospital. Robert Tools lived for 151 more days, enough time to go fishing, to talk to his children and grandchildren, and to make his peace with the world. Newsweek reporter Anne Underwood called the implantation and Tools’ prolonged survival “one of the most audacious experiments in recent medical history.”

Tom Christerson, the world’s second recipient of the AbioCor Implantable Replacement Heart and the first recipient to return home, lived for 17 months after his surgery, long enough to see the birth of his great granddaughter. Without the AbioCor replacement heart, Christerson, like Tools, would have had only 30 days to live. Before the implant, Christerson was so weak that only a few steps would leave him gasping for air. Both Tools and Christerson not only prolonged their lives but also improved the quality of their lives because they were able to leave the hospital, and Christerson was able to go home. Reporters asked them, “Was it worth it?” Christerson said, “I’ve been given a second chance at life.” Tools said, “Three months ago, I couldn’t hold my head up. I could hardly walk. I now have a new lease on life.” Tom Christerson’s son, Ken, and daughter, Patti Pryor, said about their father’s prolonged life: “Every day is a gift - it’s a day we absolutely wouldn’t have had.”

Unfortunately, most patients with advanced heart failure cannot say those words. Most heart failure patients must live the last months of their lives confined to cardiac intensive care units in the hospital.

To give other patients like Christerson and Tools first access to life-saving replacement hearts and heart assist devices, the University of Louisville, Jewish Hospital and Kentucky’s Office for the New Economy, with the support of Sen. Mitch McConnell, have joined together to form the Cardiovascular Innovation Institute. According to University of Louisville President James Ramsey, “This project has the potential to be one of the most significant and visionary undertakings in the history of the Louisville Medical Center.”

The institute will be housed in a new four-story facility on the medical campus of the University of Louisville, a block from Jewish Hospital. Construction will be completed in 2006. In the meantime, the institute will work on its implementation plan, including the recruitment of researchers to work closely with Gray and Dowling. The purpose of this document is to present the vision and initial five-year plan for the institute.



Robert Tools



Tom Christerson



The Urgent Need to Help Patients Who Have Advanced Heart Failure

Cardiovascular diseases are the leading cause of death and hospitalization in the United States and in Kentucky. The annual total cost of heart disease to our nation is \$21 billion. Kentucky has the fifth highest incidence per capita of death from heart disease in the United States. The need is urgent:

Only 5 percent of patients with advanced heart failure survive for five years.

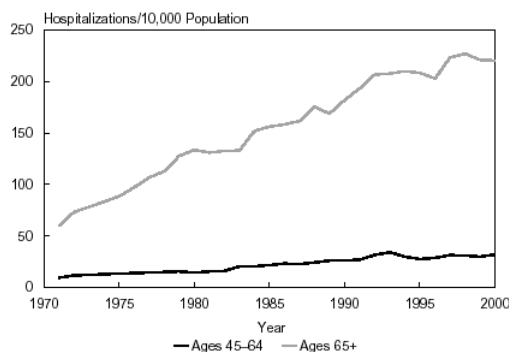
75 percent of advanced heart failure patients who are dependent on medications alone will die within one year.

According to the National Heart, Lung and Blood Institute and the American Heart Association, an estimated 400,000 people are diagnosed with advanced heart failure in the United States each year.

Almost five million Americans have heart failure. This enormous number is expected to increase because of our aging population.

Heart assist devices can help heart failure patients in three ways. First, ventricular assist devices (VADs) can be used as a temporary bridge for heart transplant patients who are waiting for a donor heart. Second, VADs can be permanently implanted in patients who are not candidates for a heart transplant. Third, VADs can be used to help the heart until it has time to recover its functioning capacity. The newer generation of heart assist devices are smaller and require less energy, making them suitable for smaller patients such as women and children.

Because these newer-generation heart assist devices are still experimental, researchers do not know their long-term effects on the natural heart and blood vessels. The Cardiovascular Innovation Institute will be uniquely qualified to test these devices both in the lab and in patients to generate concrete data on the effect of the devices on the native heart, patient survival and quality of life. In addition, because of the broad exposure to patients using these heart assist devices, researchers at the Cardiovascular Innovation Institute will be able to help industry develop the next generation of devices, what might be called **bio-adaptive heart innovations**. These next-generation bio-adaptive heart innovations will help physicians provide the best possible care for advanced heart disease patients and enable them and their families to enjoy a better quality of life.



Between 1971 and 2000, CHF hospitalization rates more than tripled for individuals ages 45-64 and 65 and older.

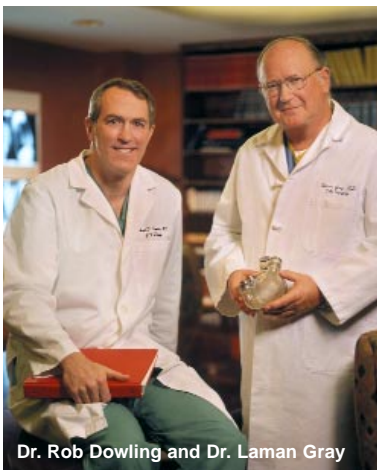
The Vision

Based on their experience over the last 20 years with heart assist devices, Dr. Laman Gray, Dr. Rob Dowling and their colleagues have the knowledge base to improve the performance of existing devices and develop them into bio-adaptive heart innovations.

One of the most promising improvements would be to combine the electro-mechanical capabilities of heart devices with the capabilities of miniature biofeedback sensors. Heart devices currently on the market have a limited ability to meet the changing metabolic demands of the body. Biofeedback sensors, however, will enable these heart devices to be much “smarter” by allowing the devices to respond to physiological changes that occur throughout the day (standing up, walking, sleeping, exercising). This new technological niche of developing biofeedback sensors will have a profound clinical and economic benefit. In the future, there may also be biologic solutions that can be integrated with heart assist devices and biofeedback sensors to further improve performance and create truly bio-adaptive heart innovations that are “living machines.”

To pursue this vision, Gray will serve as the surgical director responsible for clinical excellence. He will be joined by a scientific director who will be recruited within the next year. The scientific director will be responsible for the technical excellence of the institute. He will oversee the activities of bioengineers recruited to the institute and will interface with engineers in the Speed School of Engineering at the University of Louisville and with engineers at other collaborating universities and corporations. Together, Gray and the scientific director will develop the research-and-development agenda for the institute. This agenda will form the basis for the business plan.

The main “customers” of the institute will be the National Institutes of Health and corporations involved in the medical device and biofeedback sensor industry. Funded by research grants, the institute will provide these customers with a range of services throughout the entire product life cycle, from concept to lab to bedside.



Dr. Rob Dowling and Dr. Laman Gray



The Objectives

Test and enhance industry-created, existing heart assist devices by taking them through testing and FDA approval to early-phase clinical trials for the rapid transfer from concept to clinic, from bench to bedside

- Integrate micro-and nano-technology into heart assist devices to optimize their physiological performance as truly bio-adaptive heart innovations
- Train surgical teams from around the world to gain the required expertise to implant various mechanical hearts and bio-adaptive heart assist devices
- Generate preliminary data needed to compete for grants and contracts from the National Institutes of Health, the National Science Foundation and other funding sources
- Develop the institute's own prototype bio-adaptive heart innovations, biofeedback sensors and product enhancements
- Work with industry and start-up companies throughout the entire product development and testing cycle, with an eye on developing Louisville-based enterprises
- Develop a core competency in translating the data gathered by biofeedback sensors into useful information for adapting the performance of devices and for assisting patients and physicians to better manage patient care and improve quality of life

The Industry

Cardiovascular devices are a \$12.8 billion global industry that is growing at a rate of 12 percent per year. In addition, the projected market size for micro-medical biofeedback sensors is \$10 billion this year. Together, heart assist devices and biofeedback sensors are one of the largest and most rapidly growing sectors in the economy. Here is an overview of the industry devices for heart failure patients:

Replacement Mechanical Hearts: Complex, motor-driven, pulsatile blood pumps that are electrically powered (internal battery) and fully implantable and can take over the functioning of both ventricles after the natural heart is removed.

Pulsatile Ventricular Assist Devices: Electrically powered blood pumps attached to the natural heart to augment its pumping capacity and, in effect, take over the work of the native left ventricle. These pumps can allow an injured heart to recover, at which time they can be removed; or they can remain in place, allowing the patient to get stronger while waiting for a suitable donor heart to become available (cardiac transplantation).

Continuous-Flow Ventricular Assist Devices, also called Axial Flow Pumps: Very small blood pumps (3 inches by 1 inch in some types) that work by a magnetic impeller that rotates at incredible speeds and causes the continuous flow of blood. These heart assist devices can allow the patient to recover or wait for a suitable donor heart to become available.

Intra-Aortic Balloon Pumps: Small balloons placed in the aorta via a catheter inserted in a leg artery. The balloon augments the blood flow by sequentially inflating and deflating. These pumps are used temporarily until a heart assist device or a replacement heart is implanted or until the natural heart recovers adequate function.

Biofeedback Sensors: Microscopic medical sensors that can be embedded in human tissue and in smart bio-adaptive heart devices to measure blood pressure, blood flow, oxygen saturation or other physiologic variables. The bioengineering goal is to build microsensors to function as internal controls and diagnostics for at least five years (180 million heart beats) without having to be surgically removed. Microsensors will enable bio-adaptive heart innovations to deliver data on the functioning of the device continuously and to make adjustments in device performance automatically, without alarming the patient. The data generated by the biofeedback sensors will be converted to diagnostic information available to the patient and to the physician and will further advance medical research and improve quality of life for patients.

Other Bio-Adaptive Heart Innovations: The institute may also be involved in the development and testing of other related bio-adaptive heart innovations such as pacemakers, replacement heart valves, vascular grafts, monitoring sensors, diagnostic equipment, computer programs to run automated medical devices, surgical procedures, implantable cardiac defibrillators, surgical instruments and wearable computers to help manage patient information.





The Strategy

The institute's strategy will be to cultivate the tremendous synergistic advantages of engineers, surgeons, biologists, physiologists, veterinarians and cardiologists working together in one institute. This multidisciplinary team will focus on one goal: to improve the lives of patients who have advanced heart failure. This model will enable researchers from different disciplines to interact and share their expertise and knowledge. For example, the Cardiovascular Innovation Institute will collaborate with the University of Louisville Speed School of Engineering, where engineers work in one of only three labs in the United States that create micro- and nano-technology sensors thinner than a human hair. These tiny but powerful biofeedback sensors will improve the performance of bio-adaptive heart innovations for patients.

The institute will seek research grants from federal agencies such as the National Institutes of Health to conduct basic and applied research related to bio-adaptive heart innovations. It will also help biomedical device companies fill in the gap between the first prototype and FDA market approval of a reliable heart assist device that is safe and effective. The institute will be attractive to federal agencies and to corporate sponsors because it has all the components necessary to support research and development in one location: lab studies, device testing, design improvements, device augmentation, pre-clinical testing, FDA clinical trials, information management and, ultimately, implantation in a patient.

The institute will host an annual symposium that will attract the best minds in the world to Louisville to discuss the latest developments in bio-adaptive heart innovations. By showcasing the institute to these researchers, surgeons, entrepreneurs, government administrators and engineers, the institute will be positioned for early access to test and implant the latest life-saving heart innovations. The symposium will also be a useful component in raising funds to support the mission of the institute.

Since Jewish Hospital is an established clinical center of excellence in cardiac surgery and a federally designated transplant center, the institute is in the position to rapidly transfer ideas from the laboratory to the patient, faster than other academic sites that do not have large heart and lung institutes next door. Equally accessible to the Cardiovascular Innovation Institute is the Frazier Rehab Institute, the location of world-class cardiopulmonary rehabilitation. Many device manufacturers will need to test their devices' ability to sustain a patient during prolonged exercise. The exercise capacity of a patient is one of the objective measurements of a device's reliability and of a patient's quality of life.

Design concept, prototyping and engineering, device testing, development and improvement, clinical trials, user training, surgical implantation, and cardiac rehabilitation — all will be accomplished at the Louisville Medical Center. And once innovations have been proven in the lab and in clinical studies, there will be the opportunity to develop new businesses in Louisville around the core technologies

"The pioneering spirit that led to the success of the AbioCor replacement heart will be the guiding force at the Cardiovascular Innovation Institute," said Hank Wagner, president of Jewish Hospital HealthCare Services. "This can only mean great things for the city of Louisville and for the patients we care for at Jewish Hospital."



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Hank Wagner,
President, Jewish Hospital HealthCare Services



The Partnership

The University of Louisville and Jewish Hospital have an impressive track record of pioneering innovations in medicine during their 50-year collaboration. This year, Gray, Dowling and their surgical teams performed the 324th heart transplantation at Jewish Hospital. Some of the other notable accomplishments of the collaboration between Jewish Hospital and the University of Louisville include:

- World's first and second clinical use of the AbioCor® Implantable Replacement Heart (2001)
- World's first bridge-to-heart transplantation after the use of a Thoratec® bi-ventricular assist device (1985)
- Region's first two-year survival of a patient with a ventricular assist device (1998)
- Region's first ventricular remodeling (1996)
- Region's first dedicated heart and lung center (1995)
- Region's first implantation of the MicroMed DeBakey continuous-flow ventricular assist device (2003)
- Kentucky's first adult heart transplant (1984)
- Kentucky's first use of the Novacor® ventricular assist device (1992)
- Kentucky's first coronary stent implant (1993)
- Kentucky's first hospital to be designated as a federally approved heart, liver, lung, pancreas and kidney transplant center (1988)

This cardiovascular partnership between the University of Louisville and Jewish Hospital will now expand to include Kentucky's Office for the New Economy. That office will help translate the institute's focused biomedical research to venture capitalists and entrepreneurs so that they will invest in start-up biomedical companies located in Kentucky.

Because of the importance of commercializing ideas developed at the institute, the governance of the institute will differ from the typical University-based governance of other research institutes. The Cardiovascular Innovation Institute will be governed by a board of directors appointed by the University of Louisville and Jewish Hospital. It will oversee the activities of the institute, including approval of the annual business plan and research plan. The board of directors will be assisted by a national panel of outside experts who will consult on current and future technical developments and provide guidance in setting priorities for the institute.



Competitive Advantage: Core Competencies

The medical device industry is one of the most competitive industries in the world. If the institute is to be successful, it must offer federal research organizations such as the NIH and corporate customers a significant competitive advantage.

In other words, why would companies and government research agencies choose the Cardiovascular Innovation Institute as a partner for testing and enhancing next-generation bio-adaptive heart innovations?

- The vast surgical expertise of Gray, Dowling and their team of cardiac surgeons includes years of experience in the utilization of HeartMate, Thoratec and Novacor VADs; ABIOMED's BVS 5000; the AbioCor Implantable Replacement Heart; and the MicroMed DeBakey continuous-flow pump. Few institutions in the country have this depth and breadth of successful clinical experience with heart assist devices.
- The institute will be one of the premier large-animal surgery sites in the nation with the ability to accommodate 15 acute procedures per week and 12 simultaneous chronic cases.
- The institute will operate under the most stringent Good Laboratory Practices, which require routine calibration of equipment and standards for data acquisition and quality assurance. Good Laboratory Practices are essential for FDA market approval of devices.
- The institute can offer reduced time between the first pre-clinical studies and the first use of the device in a patient because Jewish Hospital cares for a large population of heart patients and can provide the most suitable patient for each type of device.
- The institute will employ clinical engineers, cardiovascular physiologists and bioengineers with extensive experience supporting surgical implantation and post-operative care of patients receiving heart assist devices. These bioengineers will collaborate with bioengineers at the Speed School of Engineering, researchers at other universities, industry engineers and the National Institutes of Health in evaluating and refining bio-adaptive heart innovations.
- The institute will offer corporations the opportunity to collaborate by having their researchers on site and by using the institute for training physicians and technicians on the first use of new technologies. In addition, the institute will operate under a user-friendly set of business and intellectual property practices, consistent with the University of Louisville's policies.
- An annual symposium will bring together the best investigators in the world working on bio-adaptive heart innovations. They will discuss advances at the institute and identify future opportunities for improvement and collaboration. The symposium will provide participants with a powerful "window" into the future of bio-adaptive heart innovations.





The Facility

The Cardiovascular Innovation Institute will be a four-story expansion of the existing lab at the University of Louisville Health Science Center. The institute will be one block from the Jewish Hospital Heart and Lung Institute, where the clinical team under the direction of Dr. Laman Gray performs surgery on heart assist device patients.

The institute will consist of research labs, fabrication facilities, operating rooms, recovery rooms, diagnostic equipment, training facilities, mock circulation labs, administrative offices, conference rooms, storage areas, sterile supply rooms, necropsy rooms and medical imaging areas.

The institute will be designed to facilitate multidisciplinary collaboration. It will also provide space for corporate partners who want to have their researchers work on site with institute researchers.

The cost of constructing the institute is estimated at \$23 million. The funding for this construction is already committed: \$15 million from Jewish Hospital, \$5 million from the Kentucky Office for the New Economy, and a \$3 million federal grant secured by Sen. Mitch McConnell.

“We were able to arrange for federal funding for the institute by showing the huge potential contribution for improving care for patients with advanced heart disease,” McConnell said. “This is a win-win for patients and for economic development in Kentucky. It represents the best kind of private-public collaboration.”

In addition to the funding for the new facility, the University of Louisville and Jewish Hospital will embark on a campaign to raise additional funding to underwrite the recruitment of world-class researchers, pay for the start-up costs and establish an endowment. This fundraising is described in greater detail in the business plan.

“This is a win-win for patients and for economic development in Kentucky. It represents the best kind of private-public collaboration.”

Sen. Mitch McConnell

Business Plan Highlights

A preliminary pro-forma has been developed by the institute's finance committee, which includes representatives of the University of Louisville and Jewish Hospital. This pro-forma will be used to provide the board of directors with a sound basis for making decisions as the institute is developed and after it is operational. One of the goals of the business plan is to help the institute become self-supporting after five years of operation. Here are the highlights of the initial business plan:

The anticipated expenses of the institute for the two start-up years and the first five years of operation total approximately \$30 million. The two largest components are salaries and recruitment expenses for faculty and technical staff (approximately \$13 million) and operating expenses for research and surgery (\$9 million).

The anticipated revenues for the same period total \$23 million. Federal research grants are expected to be \$9 million and corporate research grants to be \$3 million. Other revenue will come from the existing endowment from the Kentucky Research Challenge Trust Fund ("Bucks for Brains") and from current support for other on-going research activities at Jewish Hospital and the University of Louisville that will be incorporated into the institute.

The gap of \$7 million between anticipated revenues and expenses over this period will be covered by local and national fundraising efforts undertaken by the University of Louisville and Jewish Hospital. This funding is analogous to the funds that venture capital firms provide to other start-up organizations.

The tentative goal for the fundraising effort is between \$20 million and \$30 million. This will cover the gap described above, and the remainder will be used to pay expenses until the institute can become self-supporting and build an endowment to fund future operations. A firm goal will be established after more market research has been completed.

Based on the preliminary projections, the institute should become self-supporting in the second five years of its operations. This means that revenues from federal grants and corporate grants together with funds previously raised should be sufficient to pay for the anticipated level of expenses. The plan does not assume any revenue from royalties on technology developed by the institute in the first five years of operation, but this could become significant after the institute is up and running.

The business plan will be updated annually. It will provide a factual basis for evaluating performance, assessing new opportunities and ensuring management accountability. In particular, it will incorporate the projects in the research plan developed by Gray, the scientific director and their colleagues at the University of Louisville.



"This project has the potential to be one of the most significant and visionary undertakings in the history of the Louisville Medical Center."

James Ramsey
 President, University of Louisville



Economic Development

The Kentucky Innovation Act of 2000 directed the commissioner for the new economy, William Brundage, to develop a statewide strategic plan for the new economy. The strategic plan was completed in 2002 and identified those niches where the Commonwealth might gain a competitive edge within a decade and established a plan to build the infrastructure to accomplish results. The New Economy Initiative was built on three pillars: a thriving research and development capacity, an entrepreneurial business climate and an educated workforce.

One of the five special opportunity areas identified in the strategic plan is health care - specifically, the program that came to be called the Cardiovascular Innovation Institute. In support of this program, the Commonwealth provided \$5 million to help construct the facility for the institute. In addition, The Office for the New Economy has established an entrepreneurial infrastructure in the form of the Innovation Commercialization Center in Louisville to help evaluate the market potential for new ideas, to help researchers develop business strategies and plans for bringing the most promising ideas to market, and to help secure venture capital funding to launch the projects.

The basic concept of economic development is to foster the commercialization of the core competencies developed at the institute. Some of these technologies may be licensed to existing companies in return for royalties that will help support the institute and the University of Louisville. In some cases, the researchers may want hands-on involvement in launching new companies based on their ideas. In other cases, the Innovation Commercialization Center will match up the researchers with entrepreneurs and experienced business managers to help create and manage the resulting enterprise.

Over the next decade, the goal is to create a cluster of new businesses in Louisville based on the work of the Cardiovascular Innovation Institute. These businesses will be good for the researchers involved, good for the university and good for the growth of a knowledge-based regional economy.



“A focused investment in biomedical research infrastructure will make Kentucky one of the leaders in cardiovascular research and provide an engine to drive our economy”

To facilitate the development of commercial opportunities, the institute will develop a “user friendly” set of business practices that will make the institute attractive to corporate partners. Essentially, a master agreement of business practices consistent with university policies on intellectual property will be created that can be easily adapted to the specific needs of corporate partners and entrepreneurs.

“A focused investment in biomedical research infrastructure will make Kentucky one of the leaders in cardiovascular research and provide an engine to drive our economy,” William Brundage, the commissioner of the Kentucky Office for the New Economy said. “In time, we hope the institute will make us as well known for our pioneering contributions in heart innovations as we are for the Kentucky Derby.”



The Benefits

To Patients:

The Cardiovascular Innovation Institute will give patients access to the newest generation of bio-adaptive heart innovations that augment or replace the functioning capacity of failing hearts and can save the lives of terminally ill heart-failure patients. Patients will also benefit by participating in the newest FDA-approved clinical trials and thus have first access to life-saving technology. Moreover, patients in Kentucky will have access to highly trained cardiac surgeons who have the surgical experience (high number of implantations) and team readiness that smaller centers cannot offer.

To the Commonwealth of Kentucky:

The creation of the Cardiovascular Innovation Institute will further the reputation of Kentucky as a leader in the development, testing, improvement and clinical evaluation of bio-adaptive heart innovations. The institute will provide University of Louisville researchers with the support and infrastructure needed to capture more extramural funding from the federal government and industry. For every \$1 million in federal grants the University of Louisville receives, \$2.5 million is added to the local economy. The institute will also help fuel the new economy of Kentucky by establishing new business relationships in Louisville, attracting medical device companies to Louisville and developing start-up biomedical companies in Louisville.

To the University of Louisville (U of L):

University of Louisville faculty members will become more competitive for federal research grants based on new knowledge discovered at the institute. This effort can make a major contribution to U of L President James Ramsey's goals of substantially increasing the level of funded research. The institute's facilities and reputation will also enable UofL to recruit a larger cadre of federally funded medical, veterinary and engineering faculty.

To Jewish Hospital:

The creation of the Cardiovascular Innovation Institute will further strengthen the medical partnership between Jewish Hospital and the University of Louisville School of Medicine. The institute will increase the hospital's access to new research and clinical trials for the benefit of patients and for the enhanced regional and national reputation of Jewish Hospital as a heart and lung center of excellence. This, in turn, will create an expanded regional referral stream of new patients to the hospital.



Biographies

Dr. Laman Gray will be the surgical director of the institute. Dr. Gray received his M.D. from Johns Hopkins University in Baltimore, Md. He completed his training with an internship and residencies in general and thoracic surgery at the University of Michigan. Dr. Gray joined the faculty and staff of the University of Louisville and Jewish Hospital in 1974 and has been the director of the Division of Thoracic and Cardiovascular Surgery at U of L since 1976. Under his leadership, the division's faculty has conducted ground-breaking research in minimally invasive and beating-heart cardiac surgeries, cardiomyoplasty, pre-transplant organ preservation and mechanical circulatory support devices. Dr. Gray performed the first heart transplant in Kentucky (1984) and the first bridge-to-heart transplant after the use of a Thoratec® bi-ventricular assist device in the United States (1985). He was also an original investigator for the Novacor® ventricular assist device. In 1992, he performed the first clinical use of ABIOMED's SupraCor intra-aortic balloon pump and was one of four primary clinical investigators who brought ABIOMED's BVS 5000 temporary cardiac support system to clinical approval by the FDA. Dr. Gray is co-investigator for the University of Louisville/Jewish Hospital AbioCor research team. On July 2, 2001, Gray, Dr. Rob Dowling, and their surgical team implanted the first AbioCor Implantable Replacement Heart into Robert Tools, who lived 151 additional days on the device.

Dr. Rob Dowling, professor of surgery at U of L, will assist in the planning for the Cardiovascular Innovation Institute. Dr. Dowling is the surgical director of the Heart Transplant Program and director of the Mechanical Circulatory Support Program at Jewish Hospital. He received his M.D. and training in cardiothoracic surgery and transplantation at the University of Pittsburgh. Dr. Dowling is also director of the Heart Transplant Program at Kosair Children's Hospital in Louisville. He has written 85 articles, book chapters and abstracts and serves on a National Institutes of Health integrated review group.