



2006–2010 And Beyond

**VANDERBILT UNIVERSITY MEDICAL CENTER
RESEARCH ENTERPRISE
STRATEGIC PLAN**

Contents

Executive Summary	3
Elevate & the Strategic Plan	9
Introduction	11
2006 Strategic Plan Themes	14
Theme I – Personalized Health and Healthcare	15
Theme II – Therapeutic Discovery and Translation	17
Theme III – Public Health and Healthcare	19
2006 Overarching Objectives	22
2008 Foundations in Basic Science	37
Personalized Health and Healthcare Must Do's	41
Therapeutic Discovery and Translation Must Do's	46
Public Health and Healthcare Must Do's	51
2006 Educational and Career Development Initiatives	58
Priorities and the Future	68
Financial Measure of Success	70
Appendix I: Vanderbilt Centers Working in Public Health	76
Appendix II: Core Resources at VUMC	77
Appendix III: 2008 Basic Science Foundations Full Reports	88
Appendix IV: 2008 Basic Science Planning Committees	103

Executive Summary

Vanderbilt University Medical Center's mission is to improve human health. We do this not only by offering state-of-the-art healthcare and by training the next generation of caregivers and researchers, but also by engaging in fundamental basic research and clinical research that will accelerate the translation of scientific breakthroughs into better health for all people.

In the period from 1997-2004 we successfully executed a research strategic plan which greatly increased the size, the productivity, and the impact of the research enterprise. The Department of Health and Human Services, National Institutes of Health (DHHS NIH) budget doubled over this period, and VUMC greatly expanded the scale and scope of its biomedical science enterprise, growing the number of NIH-funded basic scientists in both basic and clinical departments. At the same time, the infrastructure for basic science was greatly expanded through Academic Venture Capital Fund (AVCF) investments in transinstitutional centers, allowing expansion of our network of shared core facilities, and providing unprecedented technology and services to faculty. NIH funding in the medical center increased to among the top 20 medical centers in the US.

In 2005, it became clear that NIH funding would expand only marginally over the next 3–5 years. It was felt that further investments were needed in our research infrastructure that would ensure securing federal funds in a competitive environment that was rewarding broad, multidisciplinary and translational approaches aimed at the biggest challenges in human health. Expanded investments in shared core facilities, biomedical informatics and clinical research infrastructure were prioritized, with a view to expanding our capabilities in translational and clinical research, allowing us to capture expanded NIH funding (including an NIH Clinical Translational Science Award (CTSA)) in these arenas. By 2008, overall research funding exceeded \$400m, and we joined the ranks of the top 10 US medical schools in NIH funding.

The comments provided here are summarized from discussions with departmental chairs, center directors, and faculty and staff from the 2005 planning effort, and from a subsequent planning effort in 2007-2008 focused on the basic sciences. We continually seek to: 1) leverage our existing strengths and investments; and 2) select areas where Vanderbilt can distinguish itself worldwide. Using these criteria four overall themes have emerged for structuring our priorities, as summarized below.

Four Key Themes:

Personalized Health and Healthcare
Therapeutic Discovery and Translation
Public Health and Healthcare
Foundations of Basic Science

We also defined five guiding principles:

1. Encourage and support breakthrough science of the highest quality and worldwide impact
2. Nurture our unique atmosphere of collegiality; maximize satisfaction of all stakeholders
3. Expand human research that will translate between basic science and clinical investigation
4. Diversify our portfolio of financial support for basic and clinical research
5. Utilize our space and financial resources as fairly and efficiently as possible

Objectives of Themes I-III: Planning in Personalized and Public Health and Healthcare, Therapeutic Discovery and Translation

Our 2005 planning sessions identified five overarching goals that were near-term operational and investment priorities for the research enterprise, as they benefitted multiple and large numbers of faculty. They were:

1. Establish and empower investigators to access molecular, cellular, animal and human tissue, imaging, and genomic data banks, including data available at VUMC and nationally. Create seamless linkage among data sets and position VUMC faculty to ask the *most compelling* questions
2. Develop an institutional strategy for biomarker discovery coupled to our shared technology cores and our clinical research programs—an area where VUMC can lead worldwide
3. Continue to expand support for and access to outstanding shared core facilities
4. Expand translational investigation support and increase bidirectional connection between basic science and human investigation through expanding research support services to seamlessly connect all components of the research enterprise.
5. Design and implement “big science” research initiatives that expand on existing basic science strengths to create breakthroughs in curing or preventing disease

Objectives of Theme IV: Focused Basic Science Planning

From town hall discussions with faculty in the Spring and Summer of 2007 it was recognized that a majority of the goals of the original (1997) VUMC strategic plan had been successfully met and had greatly enhanced the research and educational environment. The 2005 research enterprise strategic plan put a major emphasis on development of a stronger environment for translational research at VUMC, and important progress in meeting the goals of this strategic plan was already being achieved, as evidenced by the institution’s successful application for a \$45m NIH CTSA Award. We recognized that it was crucial that to maintain strategic balance, particularly given the growing challenges with NIH support for basic research.

To “freshen” our research enterprise strategic plan to meet the needs of VUMC in a very rapidly changing world of biomedical research, a basic science planning effort began in 2007. Six broad categories for consideration were selected for this “freshening:”

1. Enhancing Communication
2. Sharing Research Information
3. Measuring Progress
4. Remaining Competitive in Research
5. Graduate and Post-doctoral Education
6. Enhancing the Reputation of Vanderbilt Research

Theme I - Personalized Health and Healthcare. Biomedical research has clearly established that there is great variability in the susceptibility to disease, the expression of any given disease, the response to any given therapy, and the risks of untoward effects of therapy. Clearly, genetic and environmental factors play a major role in this variability. Although there is much to learn regarding the underlying causes for such variability, it is clear that we can no longer pursue a strategy of “one size fits all.” Thus, identifying the molecular underpinnings of variable disease risk and response to therapy will inform a personalized approach to disease screening and treatment. For example, who is at risk for a particular cancer will allow more aggressive screening in those individuals. Knowing who may have an uncommon but severe reaction to a given medication will protect that individual. Our goal for Personalized Health and Healthcare is to integrate fundamental discovery spanning physical, quantitative, and biological science with clinical investigation to increase the quantity and quality of data on disease processes and therapeutic interventions. A major priority is to establish real-time data linkage among the centers and departments performing basic and clinical research. These efforts will launch VUMC on a path of discovery that will individualize healthcare and transform the paradigm for evidence-based medicine.

The must-do tasks for **Personalized Health and Healthcare** are:

1. Expand our “omics” strength in metabolism and lipid arenas
2. Strengthen our image analysis and classification core
3. Create VUMC standardized descriptors for all types of data at the collection stage to permit data mining and linkage across platforms
4. Expand existing cohort trials to include diseases other than cancer and establish infrastructure to allow broader access to samples and data arising from cohort and other clinical trials
5. Establish a human investigation data coordinating center capability for multicenter trials
6. Create de-identified clinical databases and marry them to routine blood sampling (DNA Databank)

Theme II—Therapeutic Discovery and Translation. Over the past three decades, research investments have allowed scientists to make major strides in disease detection, treatment, and prevention. Academic institutions have provided biological information and have hosted clinical testing. Pharmaceutical companies have conducted lead compound identification, optimization, and evaluation. This has improved health for millions of Americans, but it has limitations. The cost of drug development is skyrocketing, forcing drug companies to pick and choose the diseases they tackle. Scientific opportunities and drug discovery capabilities have never been greater, but they are applied to fewer diseases. Vanderbilt’s strengths position it to become a world leader in drug discovery. Expanding our resources for target discovery and validation while increasing the availability of novel therapeutic reagents will give our scientists a tremendous advantage in competing for funding from NIH and other agencies. In addition, an aggressive push to establish a therapeutic discovery effort at Vanderbilt could provide valuable license and royalty opportunities.

The must-do tasks for **Therapeutic Discovery and Translation** are:

1. Expand our vivarium facilities and animal core services, including histopathology
2. Link the Center for Molecular Toxicology to our expanding program in therapeutic discovery and translation.
3. Develop a protein-based therapeutics program
4. Support and expand our small-molecule drug discovery program
5. Create infrastructure that facilitates links to nonprofit and industry partners

Theme III—Public Health and Healthcare. VUMC has an overarching strategy to improve human health. We strive to provide the right therapy to the right patient at the right time, with care that is *evidence based*. Over the past decade, healthcare has focused on improving care through industry and management techniques. This has required reorganization of our systems of care, identification of quality and safety measures, and renewed focus on patient safety throughout the healthcare system. We must use clinical information technology to accelerate advances in these areas. Ultimately, our goal is to integrate our discovery programs in public health and healthcare with research focused on personalized health and therapeutic discovery. Breakthroughs, when integrated with our molecular and bioscience discovery programs, can translate advances from the bench to the public in an efficient, safe, and cost-effective manner.

The must-do tasks for **Public Health and Healthcare** are:

1. Create an overall “institute” structure to enhance internal coordination among related areas
2. Establish a new center with research focused on the health and healthcare problems of our aging population
3. Establish a broader range of activity in epidemiology, including a Ph.D. program, as well as an M.S. and a Ph.D. program in biostatistics
4. Address diversity/disparities by increasing minority research faculty hiring and expanding diversity-based research projects *via* the Meharry-Vanderbilt Alliance
5. Establish focused international partnerships, with a priority of expanding our research programs in global health
6. Research quality assurance efforts, evidence-based medicine pathways, quality improvement dashboards

Theme IV – Foundations in Basic Science. The overall strategic plan for VUMC reaffirms a central role for basic fundamental science research as an integral component of enterprise. To foster this goal, six committees of faculty from across the Vanderbilt campus (see Appendix IV) met and interacted through the Fall of 2007 and the Spring of 2008 and solicited input from their faculty colleagues. They developed and honed a set of must-do’s for the basic sciences based on these deliberations and interactions, as follows:

Enhancing Communication

Efficient development of any institutional initiative is facilitated by unrestricted communication between all relevant constituents. However, expansion of the Medical Center over the last decade has strained the existing communication mechanisms. Four underlying opportunities for improvement were identified:

1) faculty-administration communications, 2) VUMC web site issues, 3) support for faculty in managing regulatory requirements, and 4) streamlining email communications. Three must-do items were designed to improve institutional communications at multiple levels:

1. Develop a suite of mechanisms to facilitate effective bidirectional communication between basic science investigators, department chairs, and central administration.
2. Consolidate, integrate and expand support for web-based and email communications across the entire institution.
3. Develop ways of minimizing regulatory burdens on faculty time/effort through expanding user-friendly compliance systems and direct engagement of faculty in strategies to manage compliance.

Sharing Research Information

The Sharing Research Information Committee focused on methods and procedures that would facilitate sharing of key research information, equipment, and reagents among labs at Vanderbilt. Such collegial sharing has been a hallmark of the institution, but with the astounding growth over the last decade, it is

beyond the scope of individuals or even departments to keep track of what is available throughout our labs. This results in needless duplication of effort, which in turn, lowers our productivity and competitiveness. A simple and comprehensive sharing system will allow us to leverage new projects off established ones in a way that makes the whole greater than the sum of the parts. Two must-do tasks were developed:

1. Develop an in-house searchable database that contains VU specific research information
2. Develop new infrastructure and administrative models to allow greater coordination and support for research, and tailored to the needs of basic scientists.

Measuring Progress

Vanderbilt University aspires to gain a place among the world's elite institutions in the area of biomedical research. Accomplishing this goal requires an unwavering commitment to basic research. The development of an ever more eminent faculty is tied to the impact of our publications, and to some degree their acceptance in the in the highest visibility journals. Attainment of these goals will require explicit strategies and vigilant monitoring at different levels of VUMC. Two must-do tasks were identified to address these issues:

1. Institutional leaders/Department Chairs and Institute/Center Directors must define excellence and measures of progress in terms of what is produced, beyond standard measures of NIH revenue.
2. Preserve the best aspects of our institutional culture, while increasing breadth and amounts of investment in individual basic scientists as well as innovation and new directions in basic research.

Remaining Competitive in Research

To remain competitive in research we must focus on developing support mechanisms that will further development and scientific growth of the current faculty. Flexible financial support to allow basic science investigators to explore innovative, high-risk avenues is a key to competitive success. We must anticipate a significant failure rate of these discovery-type projects. In addition, more attention must be paid to the less visible, but numerous mid-career investigators at VUMC. Finally, with the tremendous growth in the faculty and facilities over the last 10 years, it is strongly recommended that we work to consolidate the strengths we have built before embarking on a new era of rapid growth. This will preserve the tremendous investment in personnel, facilities, and organization that has been made. Must-do tasks were identified to address these issues:

1. Invest in faculty with basic support to maintain flexibility of effort, and expand investment in high-risk, highly innovative investigator-initiated projects.
2. Develop policies and support mechanisms for the maturation of trans-institutional centers and institutes.
3. Identify mechanisms to inspire and develop the careers of our best mid-career faculty.

Graduate and Post-doctoral Education

Training the next generation of scientists is a key function of the Medical Center's research enterprise. The enthusiasm and energy of graduate and postdoctoral trainees are the life blood of our research laboratories and the continued success of these trainees as they progress in their careers is used as an external measure of the success of the research enterprise. Given the importance of trainees in both generating and measuring our success, it is essential that we recruit and retain the best possible trainees. Over the last 15 years, Vanderbilt has become a leader in graduate education. Recent expansion and improvement of training efforts have supported unprecedented growth and improvement of Ph.D. granting programs associated with medical school faculty. The Graduate and Post-doctoral Education Committee focused on what should be the next key innovations in graduate and postdoctoral education that will continue to propel Vanderbilt to the forefront of biomedical research and training. Three must-do tasks for Graduate and Postdoctoral Education were identified:

1. The umbrella programs that serve as entry points into Ph.D. granting programs should receive centralized funding directly from the administration
2. The Interdisciplinary Graduate Program (IGP) should be subjected to both internal (short-term; within months) and external (within the year) review to critically assess IGP organization, IGP administration and IGP Core course content and duration. As part of the evaluation of course content, a set of well-defined core competencies should be developed for which all IGP students will be responsible.
3. Establish a liaison capability between the Graduate School and the International Office with the goals of forming alliances with international universities to recruit the best graduate students and postdoctoral fellows, expand Vanderbilt's visibility, and facilitate scholar exchange programs.

Enhancing the Reputation of Vanderbilt Research

The Enhancing Reputation Committee focused on a number of questions. How can our research excellence in specific areas be made more visible at the national and international level? How can we increase our scientific impact? In the last 5 years, we have made excellent progress with expanding the number of Institute of Medicine (IOM) members on the medical faculty, but little or no progress has been made with organizations primarily focused on basic science, such as the National Academy of Sciences (NAS) and the Howard Hughes Medical Institute (HHMI). While the Discovery Lecture series is now bringing many such individuals to campus, how could we make progress with expanding our membership in these organizations? Four must-do tasks were identified to enhance our research reputation:

1. Create an Awards Committee that collaborates with Department Chairs and other Vanderbilt leaders to identify, mentor and promote Vanderbilt faculty for appropriate honors, awards and distinctions.
2. Create a process for sponsoring national and international symposia at Vanderbilt.
3. Develop a comprehensive and appropriately targeted strategy to promote national awareness of the achievements of the Vanderbilt research enterprise
4. Commit funds and create mechanisms for targeted joint recruitment by Departments/Centers of internationally recognized senior faculty who are conducting the highest impact research.

elevate ate & The Strategic Plan

As VUMC establishes an enterprise-wide focus on workplace quality and customer service, our research enterprise is the first in the United States to adapt Studer Group “pillars” to service and employee satisfaction in a large university setting. Our objectives for the research enterprise within the five “Elevate” domains are as follows:

People Pillar

Vanderbilt’s faculty and staff are crucial to its mission and success, and their satisfaction and advancement is a major component of this plan, prefaced on the importance of nurturing Vanderbilt’s unique atmosphere of collegiality and maximizing stakeholder satisfaction. Several of our overarching objectives—such as expanded research space and linked data banks—will improve the effectiveness and ease with which faculty and staff perform. A number of must-do tasks also address people issues, including increasing minority faculty and continued investment in and recognition of faculty, staff, and students. The Education and Training component of the strategic plan focuses in part on trainee satisfaction. Most important, this plan creates an atmosphere of personal discovery and empowerment. A reduced faculty and staff turnover rate, improved new-hire retention, and faculty and staff satisfaction are benchmarks by which we will measure success in this area.

Service Pillar

Service to patients will also improve under this strategic plan. Indeed, all three plan themes (Personalized Health and Healthcare, Therapeutic Discovery and Translation, Public Health and Healthcare) speak directly to our mission to improve human health. A major thrust of the plan is to expand human research that will allow scientific breakthroughs to translate between bench and bedside, bringing effective new therapeutics and systems of care to patients. The plan reaches out to underserved patient populations, with a goal of reducing healthcare disparities and expanding research projects through the Vanderbilt/Meharry Alliance. In addition, this plan serves faculty through the development and growth of our research infrastructure. Expanded research cores, improved services supporting grant writing, and the creation of large, linked databases will allow us to offer better service to our faculty and staff. We will assess our performance by measuring how much we elevate the research community’s satisfaction with our research enterprise core and infrastructure service areas.

Quality Pillar

The purpose of the new strategic plan is to move VUMC to the forefront of research at academic medical centers in the United States—and in certain cases, the world. We will encourage and support research of the highest quality and worldwide impact. We seek to increase the quality of information on diseases and therapeutic interventions through effective use of computer science and information technology. We plan to capitalize on the quality of Vanderbilt’s research and reputation to become a world leader in drug discovery. We will identify and refine quality procedures in areas from research cores to standardized data descriptors to education and training. We will gauge our performance by measuring how well we improve the national and worldwide impact of research conducted at VUMC, as assessed through 1) measuring or success in publishing in high-impact venues within and across specialty areas; 2) expanding our faculty recognition by the National Academy of Sciences, NIH (MERIT Awards), and Howard Hughes Medical Institute; and 3) tracking success in patenting and licensing our discoveries for application in the private sector.

Growth Pillar

Our plan addresses growth priorities that include most, if not all, of the research enterprise. It drives growth in both our financial investments and resources; growth of human resources as we recruit new faculty and support staff; and growth in research space, including expanding wet- and dry-lab space and

a new vivarium. Additionally, it seeks to advance big science initiatives that will expand on existing strengths to create breakthroughs in curing or preventing disease. Increased sponsored-research awards, in total and relative to available research space, will be tracked and measured relative to our financial targets through 2010.

Finance Pillar

Indicators suggest that NIH funding will expand marginally over the next 3–5 years. Therefore, this plan structures our growth at a pace that will allow us to secure federal funds in an increasingly competitive environment. Our goals in all three theme areas will entail focused financial investments in new faculty and program support. We intend to leverage our existing strengths to diversify our portfolio of financial support for basic and clinical research. Our new therapeutic discovery programs will provide a tremendous advantage in competing for NIH funding and will provide valuable license and royalty agreements. Improvements in our research informatics infrastructure will allow us to optimally utilize our financial resources. Meeting or exceeding budgets driven by our financial targets for research development and operating expenses are the benchmarks for success in this area.

VANDERBILT PILLAR GOALS



Introduction

Vanderbilt University Medical Center’s mission is to improve human health. As an academic medical center, we do this not only by offering state-of-the-art healthcare and by training the next generation of thought-leaders, but also by creatively engaging in discovery research—basic and clinical research that will accelerate the translation of scientific breakthroughs into meaningful change in health and healthcare delivery.

This document maps the expansion of the Vanderbilt University Medical Center research enterprise through 2010 and beyond. As a research strategic plan, it defines priorities for investment of time and energy, institutional space, and financial resources through the remainder of the decade.

Development of a new strategic plan requires us to examine our assets and recent history. We are in the midst of extraordinary growth. The compound annual growth rate of our research enterprise for 2000–2004 was 20.4%, making VUMC the number-one academic medical center in the nation for growth in NIH grant awards (Duke University was second, at 15.2%; UCSF was third, at 14.4%; and the University of Washington was fourth, at 14%). This remarkable momentum pushed VUMC into 15th place overall in NIH funding in federal fiscal year 2004, up two positions from 2003. In 2007 VUMC moved into 10th place in NIH funding.

The institution has remained on task in executing its research strategic plan from 1997, commissioned by Harry Jacobson when he became Vice Chancellor for Health Affairs. In that year, VUMC was 23rd in the NIH rankings. Dr. Lee Limbird, in partnership with Dr. Hal Moses, developed a plan with input from investigators throughout the institution. This plan was the roadmap for a multi-year expansion effort. The success of that original plan is evident in almost every segment of our research enterprise. Many factors, including initiatives spawned by the successful 1997 VUMC research enterprise strategic plan, have contributed to our unprecedented growth. Key elements of our history deserve attention:

1. The Vanderbilt-Ingram Cancer Center, under the leadership of Hal Moses, experienced extraordinary expansion, quickly becoming one of the nation’s top five cancer centers. The success of the VICC has fueled development of many excellent research programs and has secured the development of shared research cores, such as DNA sequencing, that are used by investigators throughout VUMC. Indeed, our outstanding research cores have become beacons for recruiting faculty from top U.S. institutions.
2. We have successfully recruited 12 new department chairs over the past five years—many in our clinical departments, where research in 1997 lagged behind the basic science departments. Foremost among the clinical departments in recent funding is Medicine, which now has approximately \$90M in NIH funding and is number six in the United States. Among basic science departments, Molecular Physiology & Biophysics is now number one in the United States, with approximately \$25M in NIH funding. All of our department chairs, both new and longstanding, are aggressively driving research enterprise growth with visionary strategic plans, recruitment of premier faculty, and careful attention to junior faculty development.
3. The 2001 decision to mobilize more than \$100M to create the Academic Venture Capital Fund (AVCF) has spawned a number of large-scale research programs housed in VUMC but integrating investigators and resources in Arts & Science and Engineering. These include the Institute of Chemical Biology; the Institute of Imaging Science; the Mass Spectrometry Research

Center; and a zebrafish genetics program with new aquatic facilities. AVCF projects housed in University Central support a new academic computing center (ACCRES), a cognitive neuroscience initiative (CICN), and nanoscience and technology programs (VINSE, VIIBRE). These projects are having a major impact on the growth of bioinformatics and nanomedicine research programs in the Medical Center and throughout the University.

4. The Monroe Carrell Jr. Children's Hospital and the Kennedy Center are outstanding assets to Vanderbilt. The Children's Hospital opened its doors in 2004 and combines high-level pediatric and sub-specialty treatment, research, and academics under one roof. It is well on its way to recognition as a world-class children's hospital. The Kennedy Center, the second nationally designated NIH research center on mental retardation and other developmental disabilities, has evolved into an interdisciplinary research, training, diagnosis, and treatment facility. It brings together scientists and practitioners in behavior, education, genetics, and neuroscience.
5. We have made major capital investments in bricks and mortar, completing MRB III, expanding the Preston Research Building for cancer research, and initiating both MRB IV and the Imaging Institute in FY05. These buildings will add approximately 250,000 square feet to our research enterprise, bringing our total research space to approximately 650,000 square feet. In addition, the Imaging Institute will provide cutting-edge imaging technology that will expand our investigational bandwidth. These investments will catalyze the growth of our research enterprise for years to come and are foundational elements in our new research enterprise plan.

We are now in the enviable position of having successfully executed our 1997 plan. In doing so, we have increased the size, scale, and quality of the research enterprise to an even greater extent than anticipated.

Our research awards from NIH in 2004 totaled \$226.8 million, *versus* only \$94.4 million in 1999. However, the federal government is challenged by a substantial budget deficit and by security challenges at home and abroad. Indicators suggest that funding to the Department of Health and Human Services, and consequently to NIH, will expand only marginally over the next 3–5 years. While VUMC has enjoyed number-one status in grant-dollar growth on a percentage basis over the last five years, we rank only eighth in average annual absolute dollar growth. In FY 2004, VUMC grew by \$21M, while the number-one school (Johns Hopkins) grew by \$45M.

VUMC must continue to build its discovery science infrastructure at a pace that will allow us to secure federal funds in an ever-more-competitive environment—an environment where grants will reward broad, multidisciplinary approaches aimed at the biggest challenges in human health. Hence, VUMC research has reached a critical stage where strategic focus will be essential if we are to continue to grow relative to our peers and establish ourselves among the elite group of academic medical centers that will dominate the research landscape in 2010 and beyond.

The comments provided here are summarized from discussions with departmental chairs, center directors, and faculty and staff over a six-month period. We held discussions with hundreds of people in multiple venues, including executive faculty meetings, research enterprise meetings, and basic science chairs meetings. In addition, we received input from three sponsor groups and large groups of faculty at theme-focused, all-day sessions at the Center for Better Health, and at two town hall meetings open to the entire faculty and staff.

Through the Spring and Summer of 2007, the next phase of research enterprise strategic planning for VUMC was discussed with groups of faculty. It was recognized that a majority of the goals of the original (1997) VUMC strategic plan had been met and many of the goals in the 2006 research enterprise strategic were already being achieved or were being actively addressed. We recognized that it was crucial that we maintain strategic balance between basic and clinical/translational science, particularly

given the growing challenges with NIH support for basic research. Thus a “freshening” of the 2006 Plan focusing on the basic science was begun.

We believe a priority-oriented plan will distinguish VUMC from peer institutions with similar or larger research budgets and will advance our reputation and name-recognition nationally and internationally. Hence, this new plan seeks to develop areas of unique research identity and to pinpoint key areas of infrastructure that require either *de novo* creation or expansion based on focused priorities. In identifying a strategy to distinguish the research enterprise in focused arenas, we sought to accomplish the following:

1. Leverage our existing strengths and investments as we define primary areas of focus
2. Select areas where Vanderbilt can distinguish itself as best-of-class worldwide

2006 Strategic Plan Themes

Our challenge in developing a research enterprise plan differs greatly from the task our leadership confronted in 1997. By any measure the enterprise has developed extraordinary infrastructure in broad areas, with major investments in core facilities that support groups and individuals in every aspect of biomedical science. Still, while our plan should leverage existing investments, it must allow versatility to evolve at a pace that mirrors the dynamic and even chaotic advancement of science.

Through an extensive discussion with the research enterprise, we tested the hypothesis that we could take a thematic approach to structuring and focusing our plan while recognizing and supporting a diversity of interests within the Medical Center and the University. Rather than focus on specific disease entities or technologies, we sought themes that would fulfill the following criteria:

- **Ambitious.** We want to focus our research enterprise on topics in which VUMC will become viewed as number one worldwide.
- **Inclusive.** We want to include and support most, if not all, ongoing basic science and clinical research programs in the schools of Medicine and Nursing.
- **Leverage.** We want to exploit and build on existing VUMC strengths, such as our shared core facilities, and create an even richer environment for breakthrough discoveries.
- **Palpable synergy.** We want to foster unprecedented synergy between the research enterprise and our clinical and educational programs.

Three themes emerged from our discussions and provided a scaffold for our planning efforts:

► **Personalized Health and Healthcare Therapeutic Discovery and Translation Public Health and Healthcare**

VUMC faculty also identified five guiding principles that should direct our strategic planning:

1. Encourage and support breakthrough science of the highest quality and worldwide impact
2. Nurture our unique atmosphere of collegiality; maximize satisfaction of all stakeholders, including students, staff, and faculty
3. Expand research that holds promise for directly impacting human health, with emphasis on translating in both directions between basic science and clinical investigation
4. Diversify our portfolio of financial support for basic and clinical research, particularly to enhance our support from industry and technology transfer
5. Invest in administrative leadership and systems needed to allow our space and financial resources to be utilized as fairly and efficiently as possible

The following sections consider the three themes and outline “must-do” items needed to excel in all three areas. The also consider investment priorities specific to the identified areas. Finally, we offer additional suggestions for measures and programs that support our guiding principles as we expand research activity along the three themes.

Theme I—Personalized Health and Healthcare

Imagine...

Imagine an ideal world where clinicians would select the best diagnostic study and administer the best therapeutic agent through a clinical information system that is readily available, personalized, and eases workflow through integrated decision-support capabilities.

Patient-specific decision-support algorithms would arise from discovery rooted in real-time clinical practice decisions and therapeutic outcomes. They would be captured in an electronic record as a healthcare delivery by-product. They then would translate into a standard, de-identified format for aggregation and analysis at regional or national levels. Advanced automated discovery algorithms would analyze this information and detect previously unreported or unconfirmed adverse or beneficial effects—for medications as well as disease risks—based on social, genetic, and environmental factors. Genotypes, cell and tissue imaging, and proteomic data would be incorporated into these automated data-analysis processes, which would continuously look for trends correlating with clinical outcomes, such as a DNA sequence variation predicting side effects from specific medications.

Based on the trends identified in these ultra-large aggregated data sets, clinical investigators would formulate the most promising hypothesis-driven clinical trials. They would identify unanticipated drug efficacy and toxicity as well as new indications for diagnostic screening specific to genetic, ethnic, economic, and social subpopulations. These trials would capture and implement the most cutting-edge knowledge and recent discoveries in the basic sciences.

These clinical trials would yield predictive models for the most rational use of therapy or disease screening based on traditional indications (clinical phenotype) as well as genotypic and proteomic markers specific to the individual patient. These models would underpin informatics-based clinical decision support for patient-specific healthcare. They even would produce real-time warnings when a clinician's selection could yield toxicity or poor efficacy—for example, when genomic and proteomic profiles indicate that a patient is likely to be resistant to a medication, such as asthmatics resistant to beta-adrenergic bronchodilators.

The goal of Personalized Health and Healthcare at VUMC is to integrate fundamental discovery spanning physical, quantitative, and biological science with clinical investigation to improve our understanding of disease processes and therapeutic interventions.

The major challenge in implementing a Personalized Health and Healthcare vision is that present methods have almost entirely focused on the study of a single disease or a single gene, and usually both, in a research setting. While deepening our understanding of molecular mechanisms, these approaches will not allow data with high complexity, such as molecular and imaging fingerprints, to emerge as part of a meaningful data set for treating or preventing disease.

Within the next decade, it will be feasible to sequence a patient's genome and to identify and catalog that patient's unique sequence polymorphism set. Similar advances are foreseeable in cellular/tissue imaging, proteomics, and gene expression, with the added benefit that these data sets are sensitive to time-dependent changes in health status.

When viewed from a mathematical perspective, we are attempting to find the solution to a complex problem that includes a large set of unknown variables and is underdetermined. Certain clinical information, such as gender, family history, and even DNA sequence, provides baseline data that rarely change ("steady state" data), while imaging, proteomics, microarray, and clinical status change with time

and provide “kinetic” information. Large quantities of both kinds of data are essential to solving any problem of underdetermination (akin to “underpowered” in statistics). Personalized Health and Healthcare is such a problem, requiring both types of data to yield solutions.

In addition to increasing the quantity and quality of clinical and basic molecular data around disease processes and therapeutic interventions, a major priority for Personalized Health and Healthcare at VUMC is to develop computational and bioinformatics programs that will allow seamless linkage among “steady-state” and “kinetic” data. We will establish real-time data linkage among the centers and departments performing cutting-edge basic and clinical research.

Many excellent programs will contribute to knowledge in these areas, and several shared core facilities provide resources that will require focused attention:

- 1.** Our Mass Spectrometry Research Center has become one of the most advanced facilities in the nation. A fundamental component of our Personalized Health and Healthcare agenda is to seize the best opportunities to expand and improve serum and tissue proteomics core services through the Center.
- 2.** Our outstanding DNA microarray facilities have expanded into space on the ninth floor of MRB III, adjacent to the Mass Spectrometry core facilities, thus creating synergy between those programs. The microarray facility will play a key role in defining Personalized Health and Healthcare data sets.
- 3.** The Center for Human Genetics Research houses the institution’s infrastructure for DNA collection, ascertainment, and storage. It also provides unique expertise in statistical and computational analysis of complex genetic traits.
- 4.** The DNA Sequencing Core, housed in the Division of Genetic Medicine, provides DNA sequencing services to the institution. In collaboration with genetics leadership in several centers and departments, it is developing high throughput sequencing and analysis capabilities that will support Personalized Health and Healthcare.
- 5.** The Cell Imaging Shared Resource provides optical and electron microscopes and a full range of sample preparation services, image analysis, processing, and output systems to more than 200 research groups.
- 6.** The Institute of Imaging Science provides physicians, scientists, and students with a range of shared resources and with advanced imaging methods and applications in cancer, neuroscience, metabolic disorders, cardiovascular disease, and other areas. It operates top-flight facilities for imaging research at all scales, including animals and humans.
- 7.** The Department of Biostatistics offers collaboration in experimental design, association studies in genomics and proteomics, randomized clinical trial design and analysis, basic research, biostatistical modeling of biologic/clinical responses, modeling differential treatment efficacy in therapeutic research, and assessment of pharmaceutical safety in comparative studies.

Finally, inclusiveness is a strong advantage to our Personalized Health and Healthcare focus. Nearly all basic, translational, and clinical research programs within VUMC, and to a degree within Peabody, Arts and Science, and Engineering, in some way address individualized human pathophysiology. Thus, VUMC is poised to embark on a path of discovery in Personalized Health and Healthcare that will transform healthcare and healthcare delivery.

Theme II—Therapeutic Discovery and Translation

In the Future...

Jenna is one of the lucky ones. Her Parkinson's disease had progressed to the point where she was unable to move, even on medication. But Jenna was fortunate to live near one of the few centers in the world with the technology to perform a "miracle" surgery that restores motor function to patients with even the most advanced Parkinson's. Unfortunately, this surgery is not available to the vast majority of Parkinson's patients. Scientists at Vanderbilt University Medical Center have discovered a new chemical approach that achieves the same effect. Soon, this chemical approach will be tested in brain systems impaired by Parkinson's disease that now are treated only through surgery. Our dream is to develop the same relief that Jenna experienced, but in the form of a pill that is available to millions, rather than to a lucky few.

Over the past three decades, investments in basic and translational research have positioned the scientific community to make major strides in detection, treatment, and prevention of disease. The human genome sequence will serve as the framework for defining the cellular basis of disease. High throughput methodologies, which were once practiced solely in industry, are migrating to academic research. These advances offer university-based investigators high throughput screening to identify compounds with novel biological functions, high throughput crystallography to determine molecular structure, and high throughput sample preparation and analysis for proteomics.

Increasingly, these techniques are being applied in multi-investigator efforts to identify novel chemical agents with exciting pharmaceutical properties. The example of Jenna, highlighted above, focuses on neurodegenerative diseases, but similar stories are unfolding in cancer, cardiovascular disorders, and stroke.

Academic institutions have provided critical biological information through basic research and have hosted clinical testing of new agents. Pharmaceutical companies have conducted lead compound identification, optimization, and preclinical evaluation. This division of effort has resulted in improved health for millions of Americans, but it has limitations.

The skyrocketing cost of drug development has made market size a factor in selecting the diseases that drug companies tackle. A company must be assured it can recoup the money it invests to bring a drug to market. Increasingly, this means that certain diseases—called orphan diseases—are not targets of intense drug discovery and development.

According to the National Institutes of Health, diseases are orphans if there are fewer than 200,000 affected individuals in the U.S. By this definition, many human diseases, including most cancers except breast, prostate, and lung, are orphans. Thus, we face a paradox: Scientific opportunities and capabilities for drug discovery have never been greater, but they are applied to fewer diseases.

Technological gains over the past decade have allowed scientists to identify regulatory proteins and signaling pathways that play critical roles in normal physiological processes and pathological conditions. Nonetheless, drug discovery carries risks that hinder the application of new knowledge to pharmaceutical development. Drug companies do not pursue many exciting molecular targets discovered in academic laboratories because they have not been shown to be "druggable." That is, researchers have not identified "drug-like" molecules that show that inhibiting the activity of the new target alters the course of disease. Thus, although a newly discovered molecular target may reveal important concepts about disease, it may not represent a therapeutic target because proof-of-concept has not been established.

In addition, new compound identification and synthetic chemistry are critical to advancing basic biology and determining the roles of novel genes, proteins, and signaling molecules. In previous years, small molecules that interact with molecular targets of interest to biologists only existed in the compound libraries of large pharmaceutical companies. University faculty depended on industry drug discovery to

provide the small molecules needed to dissect the functional roles of proteins. These sometimes become available 5 to 10 years after their initial discovery.

Fortunately, the past decade has seen tremendous advances in combinatorial chemistry and development of large libraries of small molecules. These chemical libraries are now available to the research community, and new high throughput screening technologies allow more widespread mining of these libraries.

Vanderbilt's complementary strengths place it in an excellent position to become a world leader in drug discovery

- 1.** The combination of high throughput screening and synthetic chemistry has provided an unprecedented opportunity for discovery and development of small molecule probes of biological pathways. This has led to the formation of the Vanderbilt Institute of Chemical Biology (VICB) with support from the Academic Venture Capital Fund. While establishing campus capabilities in high throughput screening of small molecule libraries, the VICB has strengthened and established collaborations between faculty in VUMC and the Department of Chemistry. The VICB has purchased a small molecule library for high throughput screening and has collaborated with chemical companies providing access to over one million compounds that can be mined for activity at desired targets. This infrastructure provides an essential component of a credible, early-stage drug discovery effort; it is rare among academic institutions.
- 2.** Vanderbilt's Department of Pharmacology has a long history as one of the world's top pharmacology departments. It boasts expertise in each of the major areas important to early-stage drug discovery. The excellence of Vanderbilt Pharmacology has "seeded" basic and clinical departments and centers throughout the Medical Center with national leaders in broad areas of therapeutic discovery. Among academic medical centers, Vanderbilt ranks number one in the United States for the impact of its pharmacology publications (ISI, 2005).
- 3.** Through the Center for Structural Biology, Vanderbilt has invested heavily in infrastructure to allow structural determination of protein targets. Bioinformatics and NMR programs are well developed, and major recent investments are expanding our X-ray crystallographic capabilities. We possess advanced cyro-EM and EPR-based capabilities for structure determination, closely integrated with Center activities.
- 4.** Vanderbilt houses the leading Division of Clinical Pharmacology in North America. The division supports extensive collaborations between clinical and basic scientists working in broad areas relating to therapeutics. The recently formed Oates Institute for Experimental Therapeutics expands clinical and translational pharmacology resources to include investigators from all VUMC departments. Together, these entities provide extensive expertise in lipid biology, drug metabolism and pharmacokinetics, and pharmacogenomics.
- 5.** Vanderbilt has established shared core facilities that provide infrastructure needed to pursue the multidisciplinary studies required for drug discovery. These include but are not limited to a Mass Spectrometry Center; DNA sequencing, storage, and ascertainment cores; a gene array expression core; a cell imaging core; and animal and human imaging facilities in the Institute of Imaging Science. In all, 27 shared core facilities are now available to VUMC investigators, with managerial and charge-back infrastructure support by the Office of Research.
- 6.** Vanderbilt houses the oldest, largest, and most active NIH-supported General Clinical Research Center in the U.S. This Center has vast experience with supporting Phase I and II clinical trials for industry. It provides infrastructure for initial testing in human subjects of new compounds developed at Vanderbilt.

7. Vanderbilt's Center for Molecular Toxicology provides an environment for research in molecular aspects of toxicology by center investigators and faculty in the departments of Biochemistry, Chemistry, Medicine, Pathology, Pediatrics, and Pharmacology. The Center's overall goals are understanding phenomena related to toxic effects of environmental agents at the chemical level; understanding toxic effects of compounds at the biochemical level; and applying chemical and biochemical knowledge to situations involving humans.

Increasing the availability of novel chemical reagents will give Vanderbilt scientists a tremendous advantage in competing for funding from the NIH and other agencies. In addition, an aggressive effort to establish a broad, cohesive drug discovery effort at Vanderbilt could offer our research enterprise mutually beneficial interactions with industry, leading to valuable licensing and royalty opportunities.

While advancing basic science should be a fundamental force, another goal arises from the business environment, where a shift is occurring in the pharmaceutical industry approach to drug discovery. Fiscal pressures and the need for shortening drug discovery and development timelines are leading industry away from internal basic discovery efforts and toward licensing compounds and technology. This has renewed industry interest in targeted funding of discovery projects to establish an early-stage product pipeline. Through an aggressive, organized, and comprehensive approach, Vanderbilt could be at the forefront of academic institutions poised to play a central role in drug discovery and development across academic and industry sectors.

Theme III—Public Health and Healthcare

Today's challenge...

"I had a pain in my chest that dropped me on the floor." Debra, a petite 45 year old, still shudders at the memory. "It never crossed my mind that there was anything wrong with my heart. My husband rushed me to the local hospital, where we waited and waited. Because I'm young and thin and athletic, the triage nurse didn't think it was my heart. I didn't fit the profile. My husband actually had to yell at her."

The emergency room physician found two blocked arteries and Debra underwent bypass surgery, then was transferred to Vanderbilt. "My doctor is the best," Debra says. "She ferreted out my family history – my father and two uncles died of heart attacks – and explained that even though I have low cholesterol and low blood pressure, my family history put me at risk. My primary care physician never told me that. And I got great care in the hospital. When they discharged me, I got printed instructions on how to prevent another heart attack. It's in a computerized system, so no one forgets to tell the patient."

Debra frowns. "Later on I found out that my primary care doctor had gotten kits from the American Heart Association to give to women patients. They talked about heart disease risks and heart attack symptoms in women. But the kits never got handed out. I don't really blame them—the staff were too busy and they didn't have a system in place to get that type of information to the patient." Debra pauses, then shakes her head. "You want to know the irony? I was a business consultant. I taught companies how to put quality control systems in place. It never dawned on me that my health could be risked – and then helped – through that kind of system."

VUMC has an overarching strategy to improve health outcomes for people. This includes not only the reduction of morbidity and premature mortality, but also patient satisfaction.

As an institution we strive to improve the quality of public and personal health services using the framework outlined by the Institute of Medicine: to ensure healthcare is safe, timely, effective, patient-

centered, equitable, and efficient. Stated simply, our goal is to provide the right therapy to the right patient at the right time. While our objectives in personalized health and healthcare and therapeutic discovery speak to this aim, it is clear that a broader set of variables affect healthcare delivery and are fundamental to improving health outcomes.

Over the past decade healthcare has focused on improving its care by implementing successful strategies and techniques borrowed from management and industry. In recent years, the Institute of Medicine has published several reports, such as 2001's "Crossing the Quality Chasm," on quality in healthcare. This has created an urgent need to examine our own systems of care; to identify, test, and refine measures of quality and safety; and to investigate ways to increase patient safety throughout the larger healthcare delivery system.

In the early twentieth century, universities created schools of public health to research, educate, and address concerns about the health of the public outside direct healthcare. Initial attention fell on identification of environmental, occupational, nutritional, infectious, and socio-behavioral risk factors for disease, plus factors that promote disease prevention. Over time, the foci of such schools grew to include the organization of health services, including health policy and healthcare management. Targeted federal investments fueled growth for these schools in the mid-twentieth century, and traditional departments have included epidemiology, biostatistics, environmental and occupational sciences, health behavior and education, nutrition, maternal and child health, international health, and health policy and administration. Schools of public health advanced health promotion and disease prevention while training scholars, leaders, and practitioners of public health. The impact has been substantial and important.

However, medicine and public health grew apart during this time. Unencumbered by the need to teach public health, medical schools focused on traditional clinical medicine. Medical students, residents, and fellows were educated and trained in the practice of medicine and learned the core biomedical and bio-psycho-social disciplines that enabled physicians to deliver outstanding personal healthcare. By the end of the twentieth century the two schools—medicine and public health—had different viewpoints: personal health *versus* public health.

Since the 1990s, through initiatives of the Rockefeller Foundation and deans of schools of medicine and public health, it has become clear that new curricula and programs are needed to meld the two schools together. Hence, rather than create a "School of Public Health," Vanderbilt over the years has developed a number of departments, centers, and programs within existing Schools that work within these areas. These include:

- The Center for Better Health
- The Center for Evidence-Based Medicine
- The Center for Health Services Research
- The Center for Medicine, Health, and Society
- The Joint Center for Nursing Research
- The Institute for Global Health
- The Institute for Community Health
- The Center for Clinical and Research Ethics
- The Center for Genetics and Health Policy
- Department of Biostatistics

Missions and development priorities for each appear in Appendix I. This list is not comprehensive and other programs within the schools of Medicine, Nursing, and Engineering, Peabody College, and the College of Arts and Science impact this arena. Goals are:

1. To develop new healthcare delivery content aimed at diverse populations, including more effective, efficient, and compassionate methods for risk assessment, disease prevention, diagnosis, therapy, and prognosis.

2. To design, implement, and evaluate improved healthcare delivery processes, wherein methods of delivering the content of care are embedded within the structure of care.
3. To identify strategies for accelerated and transformational change management in healthcare, including evaluation of how partnerships between academic healthcare, industry, and government could anneal within these efforts.
4. To understand and improve the impact of human and organizational behavior on improving public and personal health.

Having established a critical mass of units working in these areas, Vanderbilt must organize these units to allow optimal synergy and communication. We must use our clinical information technology to accelerate advances in these disciplines. Finally, breakthroughs in these disciplines, when integrated with our molecular and bioscience discovery programs, can illuminate strategies for translating advances from the bench to diverse patient populations in the most efficient, safe, and cost-effective manner. Hence, a final goal is to achieve meaningful integration of our discovery programs in public health and healthcare with research focused on personalized health and healthcare and therapeutic discovery.

2006 Overarching Objectives

While our 2006 planning sessions focused on each of the three themes independently and identified goals that were theme-specific, all three working groups identified overarching objectives. Progress toward accomplishing these objectives will be near-term operational and investment priorities for the research enterprise leadership, as these objectives will benefit all three mission areas and large numbers of faculty.

All 2006 working groups conveyed a message that investigator-initiated (R01-type) science must remain cutting-edge, highly valued, and rewarded by the institution. At the same time, numerous faculty are committed to participating in “big science” initiatives. The working groups identified barriers the institution must address as well as new core services needed to accomplish these objectives. Of the five objectives identified in all three strategic planning sessions, four would enrich both principal investigator-driven (R01-type) and group science.

Objective 1:

Establish and empower investigators to access molecular, cellular, animal and human tissue and imaging, and genomic data banks, including data available at VUMC and nationally. Create seamless linkage among data sets and position VUMC faculty to ask the *most compelling* questions. Primary foci are:

1. VUMC clinical information systems (Star, Wiz, VPIMS, administrative systems)
2. VUMC bioinformatics to expand the capabilities of our shared core facilities, individual basic scientists, and clinical investigators
3. VUMC faculty databases (manuscripts, grants)

1. VUMC clinical information systems

VUMC’s leading-edge electronic clinical information systems assemble information about a patient and organize it for clinical access. Forward informatics techniques, parsing, concept mapping, and indexing are used to organize data into various views and to identify data needed for automated decision support. This approach permits inexpensive, rapid consolidation of all patient information. While a crucial building block toward increasing the quality, safety, and efficiency in our clinical enterprise, these systems are also critical for our research infrastructure in all three theme arenas (personalized health, therapeutic discovery, and public health). Because they are all-encompassing, these systems are developing to a degree where they will soon hold detailed phenotypic information on any patient seen at VUMC. By conducting parallel strategic planning processes, the research enterprise and the informatics center have succeeded in establishing goals and timelines in a logical sequence that will anneal VUMC’s clinical information systems into the discovery workflow of the research enterprise. These priorities include:

- Create de-identified clinical databases and marry them to routine blood sampling to provide VUMC investigators with the most complete resource for detecting unknown or unexpected molecular-phenotypic relationships for hypothesis generation. Work to establish the Vanderbilt DNA Databank is now underway (*see Personalize Medicine Must Do’s*, pg. 41).
- Provide investigators with the capability to capture categorical clinical data and outcomes from Star, Wiz, and VPIMS to assist in expanding patient ascertainment for clinical trials and to allow PIs to perform early hypothesis testing for clinical trial design. This will require development of interfaces that allow investigators, with IRB consent, to query our clinical information system databases. Build support for clinical trial management into clinical workflow and communication

tools used in day-to-day patient care through our clinical information systems. This will expedite data collection and analysis for patient-oriented research while making it feasible for more VUMC clinicians to participate in clinical research while also performing patient-care responsibilities.

- Support streamlined research administrative and compliance processes. For example, the recently formed Research Administration systems team is a group of 8 system development FTEs augmented by 4 additional FTEs in functional areas. The team is now completing the development of a web-based application to process current and future Personnel Action Form (PAF) effort distribution changes. The application will support processing of historical changes to effort allocation. As effort certification for federally sponsored contracts and grants is tied to changes in the PAF-based effort distribution for faculty and exempt staff, the effort certification process for faculty and exempt staff will be integrated into the web-based application. This application will also provide the foundation for the automation of other personnel action changes initiated at a department level. The following initiatives are targeted for consideration over the subsequent 36-month period. The order or priority of these initiatives is still under consideration.
- Development of encumbrance functionality tied to the new-hire process, the automated personnel action change processes, and the electronic procurement system (e-procurement). The team will develop reporting of commitments and actuals to budget with the goal of providing timely feedback to PIs regarding funds available on sponsored projects (Grants and Contracts).
- Upgrade of COEUS to a JAVA-based version to support the implementation of electronic grant submission capabilities.
- Development of data marts and reporting templates/forms to support access to multiple data sets to streamline the proposal submission process for PIs (access to the right information at the right time).
- Enhanced reporting capabilities to support forecasting for grant funding and effort at PI and departmental levels.
- System supported integration of the pre- and post-award processes to support a streamlined process for establishing cost centers and budgets.
- Development of an investigator portal to integrate systems for completing IRB and animal protocols.
- Upgrade of clinical trials billing processes to facilitate separation of customary charges from sponsored activity.

2. VUMC bioinformatics to expand the capabilities of our shared core facilities, individual basic scientists, and clinical investigators

A major gap in our research infrastructure is the ability to fully analyze the wealth of biological data we are collecting in our laboratories and shared core facilities. An immediate priority is establishing a Bioinformatics Resource Center (BRC) that will consist of “SWAT teams” that will assist faculty while also expanding the IT capabilities of our shared cores (DNA cores, human and cell imaging, proteomics, microarray). The BRC will be developed through the Department of Biomedical Informatics, will involve the recruitment of as many as 35 additional faculty, and will have four foci:

- **Training infrastructure and applied workshops**—Support faculty using existing tools and databases (CaBIG, custom statistical packages, NCBI genomics, imaging, molecular structure resources).
- **Collaborative IT**—Establish accessible databases in shared cores and support faculty using these resources. Develop resources in Vanderbilt’s supercomputer center (ACCRE) and eventually with the massive parallel architecture becoming available at Oak Ridge National Laboratory.
- **Integrative IT**—Web sites that integrate information from disparate data sets: DNA and clinical information, annotated tissue banks and gene expression data, cell imaging and chemical structures, etc.
- **Comparative IT**—Systems biology: comparing data across multiple platforms to identify new patterns—tissues and cells, molecular pathways, model organisms, toxins, etc.

We have analyzed in detail the approach to developing bioinformatics faculty teams capable of expanding the scope of our research enterprise in the four areas outlined above. A representative list of faculty competencies that we will develop in biomedical informatics, and will complement existing and planned expertise in other departments and centers, includes the items on the following list:

	Faculty Competencies in Biomedical Informatics
Database design	Computerized repositories of data are the <i>sine qua non</i> of most research and clinical systems. Data and database modeling is a fundamentally important aspect of system design and implementation.
System Architectures	Designing the overall blueprint for flow of data and information into and out of databases and associated information retrieval and analysis tools is a major component of designing systems architectures.
Vocabularies	The naming and coding of biological and clinical entities provides the basis for reliable search within information resources and linkages among resources.
Data Mining*	Methods for detecting relationships within large collections of data, and approaches to establishing relationships among heterogeneous databases (including those created for different purposes and without the original intent to support external linkages) are the focus of data mining.
Expert Systems	Computing systems that embed the knowledge of human experts to support goal-directed reasoning has application in a broad range of areas, including clinical diagnosis, therapy planning, epidemiologic surveillance, and molecular structure-function prediction.
Knowledge Architectures	Creation of ontologies that encode facts and the relationships among those facts is a central focus of the skills involved in designing and maintaining knowledge architectures.
Discovery Methods and Systems*	Adaptive systems that improve their performance and systems capable of automatically detecting patterns and associations within complex data sets are examples of methods that can be applied to both molecular and clinical data.
Scientific Visualization*	Ability to turn the relationships present in large volumes of numerical data into pictures is an important analytical capability in the era of data-intensive life science.
Human Factors	Perceptual psychology and cognitive science aspects of user interface design and system performance can determine whether an application of information technology is widely and effectively used or abandoned by its intended audience.
Educational Processes	There is often a gap between teaching and learning, and the study of computer-based and computer-assisted educational methods is a component of applied informatics in educational settings.
Evaluation*	Formal technology assessment methods about process and outcomes can provide scientific knowledge about the effects of information technologies in research, education, and healthcare as well as evidence for return on investment in business environments.
Modeling	Computer-based simulations and modeling can be useful for most objects or systems that have measurable properties and multiple interacting components. Modeling methods are applicable in diverse settings, including single molecules, cells, tissues, biochemical pathways and systems, and organizational processes.
Organizational Development	The management of modern healthcare enterprises, the information infrastructure that supports that management, and the sociological aspects of change within organizations are closely linked to information systems and their role in workflow and governance.

*DBMI and the Department of Biostatistics collaborate in these areas.

The competencies and research areas listed above are relevant to a variety of applications and classes of data and information. The following table summarizes the importance of each to Vanderbilt's mission of research, education, and patient care. While this bioinformatics "need table" will require reevaluation as priorities evolve, it is useful for prioritizing faculty recruits to populate the BRC "swat Teams." The table

represents the skills of faculty members across bioinformatics, clinical care, and organizational development.

	Importance of Competencies in Selected Areas				
	Alphanumeric Clinical Systems	Clinical Imaging	Molecular Biology & Genetics	Integrative (Systems) Biology	Molecular, Cell & Tissue Imaging
Database Design	+	+	+	+	+
System Architectures	+	+	+	+	+
Vocabularies	++		++	+	
Data Mining	+		++	++	+
Expert Systems	++	+	+	+	
Knowledge Architectures	++	+	+	+	
Discovery Methods & Systems	+	+	++	++	+
Scientific Visualization		+	++	++	+
Human Factors	+	+	+	+	+
Educational Processes	+		+	+	
Evaluation	+	+	+	+	+
Modeling	+		+	++	
Organizational Development/ Management	+	+	+		

New competencies, methods, and technologies will emerge and additional applications will become important within VUMC's mission. Targeting recruits to develop and maintain faculty capabilities commensurate with organizational needs will be an evolving management task. Matrices such as those above should be revisited annually through consultation with research, education, and clinical enterprise constituencies.

Within the goal of comparing data across platforms is a priority to provide a shared research data-management infrastructure that will enable VUMC investigators to share data across platforms. An example is "Meta-Data," which is already in development and will allow investigators to access data across proteomic and microarray shared core platforms. It will tie these data to phenotypes gathered in VUMC clinical information systems.

3. Faculty databases

The faculty database, coordinated through the Office of Biomedical Research Education and Training (BRET), currently serves as a research enterprise information source for internal and external faculty, staff, students, and others interested in VUMC. Recently, the BRET database search capabilities have been expanded and linked to external information sources, including PubMed abstracts, to broaden and improve content. A keyword search now returns information based not only on the profiles stored in BRET, but also on citations of published papers. VUMC faculty and the Office of Research are now considering the inclusion of submitted grant application abstracts, with appropriate permissions and security protections. These efforts are moving us closer to the vision of a fully integrated, searchable database—a "StarResearcher" or "VanderGoogle"—that will allow the cross-connectivity articulated in strategic planning sessions. We envision a database that our researchers will use for writing and submitting grant applications, for writing and submitting manuscripts for publication, and for establishing connections for multidisciplinary, transinstitutional research collaborations.

Objective 2:

Develop an institutional strategy for biomarker discovery coupled to our shared technology cores and our clinical research programs—an area where VUMC can lead worldwide.

In the last century, disease diagnosis and therapy has been based on qualitative analysis of symptoms and painstaking visual inspection of organs and tissues. Now, in the genomic era, biomarker characterization is a realistic means to accelerate the diagnosis and therapy of diseases, including cancer, infectious disease, hypertension, and diabetes. Mass spectrometry, chemical biology, and imaging science are delivering pathways for developing biomarkers that will provide molecular precision in the full continuum of disease management, from diagnosis to therapy.

Understanding the initial molecular changes associated with drug response has the potential to revolutionize the drug discovery process. Fiscal pressures on the pharmaceutical industry and growth in the cost of clinical trials have created an urgent need to improve the economics of drug discovery. Of the typical \$800M investment in a new therapy, most of the cost is accrued during the latter stages: Phase III studies with large human populations. Failure at this stage due to toxicity or poor efficacy yields extraordinary unrecoverable costs. Technology allowing identification of clinical biomarkers that predict efficacy or toxicity in early human trials or animal studies would revolutionize the pharmaceutical industry. This kind of breakthrough has the potential to remedy the nation's criticized low throughput in bringing new therapeutic agents to the marketplace. Three areas of focus include:

1. Establishing the fundamental gene expression patterns in major forms of disease, thereby defining VUMC as a key player in the field of molecular pathology.
2. Defining the role of mass spectrometry as a key technology for all stages of drug development through accelerating the identification of toxicity or efficacy of early stage compounds.
3. Identifying biomarkers that allow drug therapy to be personalized to the individual patient; monitoring that therapy for efficacy and/or toxicity throughout disease management.

Direct tissue analysis using profiling, imaging, and mass spectrometry brings new and powerful capabilities to both clinical and basic research, allowing thousands of protein biomarkers to be measured with molecular weight specificity. The synergy of these efforts, coupled with efforts to understand DNA variation, will identify a suite of molecular markers that can be used in disease diagnosis, assessment of specific disease subtypes, elucidation of disease progression, and monitoring of drug safety and efficacy. Our mass spectrometry center is already an innovator in this arena and the pharmaceutical industry has shown immense interest in its advances.

- Our first priority will be to identify the means to leverage our technology in shared cores toward fundamental biomarker discovery. While investigators are engaged in these efforts, we will expand *via* strategic recruitment of additional investigators working at this interface. Many of these researchers will have a primary interest in biomarker and drug development focused on a particular disease, such as cancer, neuroscience, or cardiovascular disease. The Stahlman “John Oates” chair poses an opportunity to recruit leadership in one of these areas.
- A second priority will be to expand our well-developed and prominent programs in metabolism and drug distribution in pharmacology and clinical pharmacology. We also will establish greater linkage between these programs and our shared cores, particularly the mass spectrometry center. This will require focused recruiting, as the number of faculty working at this interface is now small.
- A third priority will be to expand patient-oriented investigation in biomarkers. One approach is to expand our NIH-supported GCRC “review committee” infrastructure to include consultation from our shared core leadership, who could help identify the clinical trials that best lend themselves to biomarker identification. The goal would be to initiate biomarker discovery early in the clinical trial design phase, rather than as an afterthought.

Objective 3:

Continue to expand support for and access to outstanding shared core facilities.

Since implementing the research strategic plan of 1997, VUMC has heavily invested in shared core facilities. Their excellence has been a beacon for attracting outstanding faculty to the Medical Center while enhancing the scientific breadth and productivity of our existing faculty. In general, each shared core is managed by a principal investigator whose research is interwoven with the activities of the core, thus ensuring core technology remains at the cutting edge. See Appendix II for a description of each core.

Core facilities are operated under a shared management strategy that focuses on keeping science under the purview of scientists. Each core has a tenured faculty member as core director. The core's full-time operations manager holds at least a master's degree in science and manages the core's day-to-day functions. One hundred percent of the manager's time is devoted to core science and technology. The Office of Research offers financial and budgeting oversight, including overseeing pricing and advisory committees. The core advisory committee meets annually to review core resources and technology to determine if any technology has become outdated or common. This shared core oversight—science working with administration—creates a dynamic synergy that allows each core to operate at peak effectiveness. A final, key element in core success is stable funding that is written into grants. The VICC, the Diabetes Center, and the Digestive Disease Research Center have been particularly important in securing stable financial support for our shared cores.

A clear message of the research strategic plan is to continue to develop shared cores in this centralized model. Immediate priorities for new cores include:

1. **Centralized tissue banks for human and animal tissue and cell lines.** This will assure quality control standards, optimized collection, standardized annotation and consent, broader and simplified investigator access, and security. It will also be necessary to develop IT support through web-based interfaces accessible by PIs.
2. **RNA interference core.** This will offer two opportunities for discovery of novel molecules involved in cellular/molecular function. The first would be a resource of genome-wide libraries (human and mouse) of plasmid-based shRNAs, stored as bacterial stocks and suitable for individual requisition by faculty. The second resource would be a library where individual siRNAs are plated in formats compatible with HTS screening.
3. **Protein expression/purification core.** For details, see “Develop protein-based therapeutics research” under Therapeutic Discovery and Translation Must Do's (page 47).
4. **Expanded biostatistical support for animal and human studies.** This is vital to increasing the quality and quantity of research carried on throughout the research enterprise, and will be developed under the supervision of the Department of Biostatistics. Improved service will benefit research programs and investigators by developing study designs that are efficient, easy to interpret, and enhance ethical research conduct. It also will promote modern experimental design that terminates when sufficient evidence is demonstrated or extends experiments when results are equivocal. Our expanded biostatistics core will house data in secure, web-based data management systems and archiving databases and will be analyzed in a powerful, robust, and reproducible fashion. Finally, it will use modern statistical graphics for optimum communication to nonstatisticians.
5. **A data coordinating center that will allow VUMC to host large multicenter clinical trials.** The Departments of Biostatistics and Biomedical Informatics will house the Data Coordinating Center, which will serve specific multicenter studies. For a detailed description of the proposed Data Coordinating Center, see Must-Do Task 5 under Personalized Health and Healthcare Must Do's (page 43).

6. [Expanded epidemiology support services](#), particularly in areas outside cancer (see Center for Epidemiologic Research, page 52).
7. [Resources to assist investigators in assembling large, multi-investigator grants](#). The Office of Research is directing resources and manpower to assist researchers with obtaining large, multi-investigator grants. This includes hiring a professional writer who edits grants and works with PIs to manage the process of compiling large grants, and redesigning the Office of Research web site to include:
 - a. An annotated sample grant, example text, and downloadable text commonly used in grants (e.g., Resources and Environment)
 - b. Grant-writing tools, guides, and resources
 - c. Current information on NIH, training, and private grants/awards
8. [An office to mine research enterprise intellectual capacity and identify opportunities for synergy with industry](#). We have recruited a physician scientist with a background in basic science, clinical investigation, and industry who will establish links between the research enterprise and outside entities for strategic partnerships, sponsored research, and joint ventures. Familiarity with VUMC intellectual capital and intellectual property will allow us to leverage that knowledge to expand outside relationships. By reporting to the Associate Vice Chancellor for Research and interacting with the Director of Strategic Planning (responsible for developing large-scale, cross-disciplinary scientific programs and multi-investigator grant proposals), this person will ensure that large-scale initiatives are leveraged into broader outside financial relationships. The position will relate closely to the Office of Technology Transfer and Enterprise Development for Vanderbilt University and to the Director of Drug Discovery in Pharmacology and the VICB. The individual also will work closely with department chairs, division, chiefs, and center directors to package their intellectual capital for outside entities.

Objective 4:

[Expand translational investigation support and increase bidirectional connection between basic science and human investigation through expanding research support services to seamlessly connect all components of the research enterprise.](#)

Programmatic Issues

Translational research merges the explosion of new biology with the systems needed to facilitate communications between bench and clinical researchers, to assist with prioritization of molecular candidates, and to create a safe but efficient environment to clinically investigate promising agents and novel modalities for disease prevention, diagnosis, and therapy. It presents a major challenge to our academic, industry, and governmental healthcare systems. The infrastructure required for translational research has expanded beyond the intellectual bandwidth of most investigators, even those trained as clinicians and scientists. Clinical research alone touches—and is dependent upon—a multitude of domains that do not routinely communicate with each other, and it requires investigator experience beyond typical medical training. Translational research requires a strong clinical research enterprise and active collaborations between clinical investigators and basic scientists in biomedical, behavioral, and epidemiologic disciplines. A strong and stable translational research program requires:

1. Support for the recruitment and training of a new generation of clinical investigators, and strategies aimed at the professional development and advancement of these individuals
2. Support for the continual improvement of infrastructure to expand the bidirectional transfer of cutting-edge discoveries and resources between the basic sciences and clinical investigators

Recent NIH initiatives, including the NIH Roadmap, are challenging universities to examine how the constituencies of research interrelate, and to re-engineer their systems to eliminate roadblocks,

redundancies, and inefficiencies. Over the last five years, Vanderbilt has centralized and organized infrastructure supporting basic, translational, and clinical research. At the same time, we have avoided “centralizing” the intellectual capital intrinsic to these areas, recognizing that their integration across disciplines is critical to their individual and combined success. Our challenge has been to develop a flexible and robust infrastructure model for all research areas, to link the diverse resources fundamental to both basic and clinical research, and to make them accessible and expandable as biomedicine evolves. We have restructured our research enterprise to centralize and share resources when such an approach makes sense from a business and scientific standpoint. These resources extend to nearly all investigative areas, including animal care and core facilities. Our Office of Research supports these at an organizational level while managing a vast web of resources and strategic initiatives affecting basic, clinical, and translational research within and outside the Medical Center. An Assistant Vice Chancellor in the Office of Research manages and supports all clinical research regulatory and service areas (e.g., IRB, Grants and Contracts) while at the same time providing needed input into institutional initiatives that relate to or rely on clinical research resources and infrastructure. Close ties between the Office of Research and the Deans of Medicine and Nursing assure alignment of research resources with faculty recruitment, support, and advancement.

Encouraged by the NIH Roadmap and our own positive experience with this model, the Office of Research has expanded to allow seamless integration between clinical research cores and traditionally separate entities, including research-related contracting, technology transfer, pre- and post-award finance, clinical trials organizations within centers and departments, the GCRC, and clinical and basic science information technology programs. Further resources are needed to help investigators navigate infrastructure supervised by these offices as well as those administered by the deans of our schools, and our departments and research centers.

Hence, over the last year the Office of Research has assembled a team knowledgeable in research infrastructure areas (IRB, Grants and Contracts), training programs (K awards, including the K30 core service educational programs), and research centers throughout the Medical Center and University. This team, known as Research Support Services (RSS), assists investigators in navigating the complex processes of clinical research. It will also help basic scientists translate their discoveries to clinical research platforms through interaction with our shared core facilities and/or clinical research areas, such as the GCRC. The mission of the RSS is to provide one-stop shopping for expertise and services related to all areas of Medical Center research.

Reporting lines for major research support and infrastructure are focused and aligned within the Office of Research. A single Assistant Vice Chancellor, reporting to the Associate Vice Chancellor, is responsible for the IRB, RSS, and Grants and Contracts, allowing synergies and efficiencies that achieve a better product and quicker problem-solving. In this model a single office is therefore accountable to the investigator attempting to navigate the system. It is now far less necessary for our clinical investigators to contact multiple independent offices, or to become experts in the regulatory requirements or administrative processes required to conduct human investigation. RSS consultants are experienced in research, regulatory affairs, contract negotiations, conflict-of-interest issues, technological transfer, funding identification, regulatory communication, patient advertising and recruitment plan development, research staff training, and preparation of study-related documents or databases (developing protocols, case report and consent forms, and investigator drug brochures).

Further, if a basic scientist seeks to propel a discovery from the bench to the bedside, RSS provides guidance through the translational process. Help might include identification of and introduction to a shared core that can assist in identifying an antibody or biomarker, or an ombudsman service to help triage and navigate the best use of multiple cores. It also could include brokering interactions with our data analysis cores for analyzing data sets, or accessing our GCRC, industry sponsors, or research centers to initiate Phase I clinical trials. The services of RSS are free through an information hotline, via e-mail, or in person.

In summary, the Office of Research will continue to centralize and optimize the infrastructure, resources, and coordination of the research enterprise while allowing discipline-specific arenas of clinical and translational investigation to flourish within existing academic departments and centers.

The Office will continue to provide programs and staff to identify and eliminate barriers to translational research, to assist with developing clinical research projects, and to coordinate the research center and department activities related to clinical investigation. The number of Research Support Services consultants will expand; they will be trained to extend the reach of clinical investigators into the basic sciences while assisting basic scientists in translating their discoveries into clinical research. The Office of Research will monitor the RSS staff and evolve this team as need and resources permit.

Facility Issues

VUMC is not immune to the competitive forces of its marketplace, as competition is fierce among academic medical centers for the dollars to finance research and for the intellectual assets represented by the researchers. To compete, VUMC must provide scientists with access to essential infrastructure. Increasingly, as the NIH demands proposals that include applied components tied to basic discovery, investigators we wish to recruit and retain will require that we provide research space designed to meet the needs of translational and clinical applications (so-called “dry-lab” space).

The institution’s wet-lab space is costly to build and maintain and thus is not cost-effective for serving clinical and translational research objectives. The cost of constructing wet-lab space is roughly 50% more than the cost of dry-lab space (possibly excluding vivarium space). Therefore, reallocating existing wet-lab space for this purpose, even if it were available, is not economical. MRB IV, slated for completion in October 2006, will house new research programs heavily aimed at personalized and therapeutic discovery. At the same time, it will expand our need to develop connecting “applied” research space. To support our efforts to expand programs with faculty and staff that will resource these investigational areas, VUMC is in the planning stages of designing ~200,000 GSF of new “dry-lab” space to meet our needs over next 5–7 years. The most likely construction site for this facility is atop the new parking facility replacing Medical Center South. This location provides excellent adjacency to the Vanderbilt Clinic, The Children’s Hospital, and Peabody College, and will be easily accessed through TVC by the basic science areas in Preston, Robinson, Light Hall, and MRB IV.

Completion of this space, the so-called “Applied Biomedical Research Institute” (or “dry lab” research facility, final name under consideration) represents Vanderbilt’s next step toward providing space and facilities essential to realizing our bench-to-bedside vision and to nurturing our intellectual assets. Financial analysis indicates that the project is viable and will enhance the operating results of the Medical Center in the future through capital recoveries and other indirect costs from federal and other sponsored research activities. The activity to be conducted in such space also lends itself to the generation of philanthropic support. The Applied Biomedical Research Institute will be a unique facility in the United States and will provide a clear competitive advantage for VUMC faculty shepherding bench-to-bedside research programs that will impact the future health of the nation and the world.

Objective 5:

Design and implement “big science” research initiatives that expand on existing basic science strengths to create breakthroughs in curing or preventing disease.

Some of the most significant breakthroughs in science are yielding to multidisciplinary efforts by investigators trained in diverse research disciplines, from developmental biology to physics. Vanderbilt is well positioned to tackle problems of this nature, thanks to our existing multidisciplinary centers, our collegial atmosphere, and our physically integrated campus. At the same time, multidisciplinary research aimed at solving a single problem (a disease cure or an early diagnostic test) using resources on an ultra-large scale (hundreds of faculty and staff) has not been attempted at many academic centers for a variety of reasons.

First, most existing extramural funding mechanisms do not support initiatives of this scale (the Human Genome Project is a possible exception). Second, NIH granting mechanisms are still designed to credit a single PI, although there has been movement at NIH suggesting a desire to modify this practice. Third, the culture of academic medicine has long been biased toward R01-funded science, which is focused on the expertise of one or a few faculty members.

A further barrier to adoption of big science initiatives in universities is the lack of a well-defined institutional infrastructure whose purpose is to establish cohesion, implement strategy, and provide support for developing these projects. Moreover, the substantial “activation” energy needed to launch a large project involving many centers can delay or inhibit generation of a solid, timely proposal.

Using professional program management personnel in the Office of Research Support Services (RSS), VUMC this year began two large-scale initiatives aimed at establishing infrastructure that will facilitate future “disease-cure” big science initiatives: 1) response to an RFA designed to establish a Clinical and Translational Science Awards program (CTSA), and 2) the rapid creation of a large-scale DNA bank linked to de-identified clinical data. The CTSA project will link together our NIH-supported GCRC and our many advanced training programs in clinical and translational research while leveraging and expanding our cohesive research infrastructure programs (IRB, Grants and Contracts, RSS, animal care, shared cores) with a view to optimally supporting the clinical and translational investigation “process,” as well as faculty investigators in this field. The DNA databank project is an ambitious effort to develop the world’s premier databank—linking over 500,000 DNA samples to de-identified clinical data and leveraging our advanced clinical IT capabilities—within 5 years (see *Overarching Objectives*). The complex, multidisciplinary nature of these programs has reinforced the need for *professional program management*: experienced administrative personnel with strong science and organizational training who can manage large and diverse entities. Such persons may have MBA or other business-organizational training, along with experience in research. These individuals will facilitate the establishment of future big science efforts in a way that has never been attempted in academic centers.

Research enterprise planning sessions grappled with how to perform an increasing number of big science projects in an academic medical center while maintaining an emphasis on the investigator-initiated science that is the backbone of our research. This is uncharted territory, and while many of the obstacles (funding, administration) are known and can be managed, many will be discovered in process. Hence, we will incrementally add 1–2 projects per year, and we view the initial projects as opportunities to gain valuable experience that will inform the successful management of future projects. At the same time, we will continuously evaluate new big science initiatives.

Clearly, projects such as these will require financial support in NIH grant funding, and philanthropy. Moreover, Chancellor Gee’s recent announcement at the fall faculty meeting of a new Academic Venture Capital initiative presents another opportunity to identify resources that would jump start one or more big science initiatives aimed at solving critical problems in health and healthcare.

Big science initiatives will be selected when we identify a high-impact problem in health and disease where we have a strong critical mass of faculty interested in tackling the problem and where there is significant potential to *solve the problem* with a highly focused effort within 5 years.

Big Science Projects: Year 1

1. **Early-detection plasma screen for colon cancer**—a project that recently received \$10M in philanthropic support from Jim Ayers. This gift has enabled Vanderbilt to create the Jim Ayers Institute for Pre-Cancer Detection and Diagnosis. Research at the Ayers Institute will focus on identifying patterns of protein expression that signal the presence of pre- and early cancers and that help predict how tumors will behave. This will allow selection of the most effective treatment. Institute research will build on Vanderbilt’s strengths in proteomics and will have significant implications for a wide array of cancers and other diseases. The first priority for Ayers Institute researchers will be identifying molecular markers for colorectal cancer. Because the incidence of and mortality rates from colorectal cancer are highest among African

Americans, this priority dovetails well with our strategic plan's focus on addressing diversity/disparities by developing large-scale, diversity-based research (see page 55). This complicated endeavor will involve collecting and analyzing a huge amount of data and ultimately will involve clinical trials among many participants at collaborating centers across the country. The project will involve up to 100 faculty and staff and will include at a minimum:

- Vanderbilt-Ingram Cancer Center
- Nanomedicine Programs (UC, VUMC, ORNL)
- Mass Spectrometry Research Center
- All basic science departments
- Medicine: Oncology and GI Divisions
- Surgical Oncology
- Pathology Department
- Vanderbilt Institute of Chemical Biology
- Department of Biomedical Informatics
- Department of Biostatistics

2. **Creation of a pharmacoinformatics system that detects and eliminates adverse drug effects in patients.** Drug therapy continues to be plagued by an unacceptable rate of adverse events (as high as 5% in many hospitals throughout the United States). Vanderbilt is making excellent strides toward eliminating errors in drug administration using Wiz and other decision-support systems. The hospital is moving rapidly toward bar-coding that, in tandem with our on-line decision-supported drug order entry capabilities, will create a closed-loop drug order and administration system that will nearly eliminate the risk of subjecting our patients to *known* adverse drug reactions. However, the problem of how to identify the adverse drug reactions we cannot yet predict looms as a significant challenge. Indeed, a defining characteristic of the recent pharmaceutical landscape is high-profile drug withdrawals, mostly due to unanticipated toxicities in small numbers of patients that become apparent in post-marketing surveillance.

The goal of this big science project is to substantially reduce the uncertainty involved in pharmacotherapeutics by coupling the genetic information obtained through the DNA databank project to drug reaction phenotypes in our de-identified database and other databases that accumulate reported toxicities. Our goal is to provide this information to physicians through Star Panel or other on-line tools as a "genotype profile" with decision support to assist them with dosing and drug selection decisions. Through this approach, we will reduce the rate of drug toxicity for FDA-approved agents in out- and in-patient settings. We also will make it possible to reintroduce specific drugs to the marketplace in a manner that avoids their use in select populations at risk for complications while allowing their use in the much larger population with a favorable risk/benefit profile.

The key to this effort will be the establishment of a large pharmacotherapeutics knowledge base coupled to interactive, intelligent tools that can extract and represent the contents of VUMC (or outside) medical records with other disparate biological databases from the FDA and other agencies. These databases will support hypothesis-driven and hypothesis-free (unbiased data-mining algorithms) exploration and discovery that will add to the knowledge base at an unprecedented, exponential rate. As the knowledge base reaches critical mass (approximately Year 3), we will select one or a few known drug toxicities and use the knowledge base to evaluate this information to reduce the rate of toxicity events within our healthcare system.

An example pilot project under consideration is to use the DNA databank to greatly expand our knowledge of genotypes that impact blood coagulation. After three years of data mining and acquisition to expand the knowledge base, we would enroll patients in clinical trials where they would consent to DNA sequencing. We would use this information to inform care providers regarding the dosage and selection of medications that could impact coagulation and bleeding, such as heparin, warfarin, aspirin, or nonsteroidal anti-inflammatory medications. We would measure the rate of coagulation-associated complications, such as bleeding or deep venous

thrombosis, and the efficacy and cost of anticoagulation monitoring in a setting of genetically informed pharmacotherapeutics.

The long-term mission of this project is to generate a progressive series of robust and flexible resources, available nationwide, that analyze large, diverse datasets to improve drug use and enhance drug safety. The project will allow us to discover new drug actions and reactions in the population far more rapidly than through existing anecdotal post-marketing surveillance. By creating a national electronic network that can track the effects of newly approved drugs on individual patients and patient populations, we have the potential to bring new therapeutics to the public with less front-end cost and unnecessary delays due to low-yield testing for rare complications. In summary, this effort has the potential to revolutionize our approach to drug development.

Key stakeholders in the project include, but are not limited to:

- Department of Biomedical Informatics
- Department of Pharmacology
- Department of Medicine (Clinical Pharmacology and many other divisions)
- The Oates Institute of Experimental Therapeutics
- All disease-theme Centers and Institutes

Additional Potential Big Science Projects: Years 2-5

- 1. Autism.** More than 150 investigators are members of the Vanderbilt Kennedy Center for Research on Human Development, working on the genetic, neurodevelopmental, and environmental causes of atypical brain development that lead to developmental disabilities, including one of the most common, autism. Behavioral scientists, special educators, neuroscientists, pediatricians, pharmacologists, and imaging specialists are taking a multidisciplinary approach to this mysterious disease—often in collaboration with fellow researchers across the country and around the world. This group of talented scientists works as a unified team on various aspects of autism, with a goal of improving early diagnosis and developing better, more effective interventions. This team-science effort values the contributions made from different disciplines that have a unified goal of defining the links among genetics, the brain, and behavior. Over the past 10 years, science has made great strides in identifying the genes involved in autism. Vanderbilt geneticists have participated in the Autism Genome Project—a global effort that has completed the most extensive study to date on the location of genes involved in autism. Once these genes are targeted, we will be several steps closer to detecting, treating, and perhaps even preventing this disorder. But work doesn't stop with gene identification. Vanderbilt researchers are taking multiple paths—including imaging techniques, screening methods, behavior analysis, and studies of social and familial effects—to reach the same goal. These paths can be integrated toward the goal of developing a combination of pharmacologic and behavioral interventions which, if used early in patients at risk, reduce the morbidity of autism. Key stakeholders in such an endeavor would include, but are not limited to:

- The Vanderbilt Kennedy Center for Research on Human Development
- The Center for Human Genetics Research
- The Center for Molecular Neuroscience
- Department of Pediatrics
- Vanderbilt Institute for Imaging Science
- Department of Radiology
- The Department of Pharmacology
- Peabody College (Departments of Special Education and Psychology and Human Development)
- Department of Neurology
- Department of Psychiatry

- Center for Structural Biology
- Vanderbilt Institute for Chemical Biology
- Department of Biochemistry
- Department of Molecular Physiology and Biophysics
- Department of Biostatistics

2. **Identifying patients at risk for depression.** Major Depression (MD) is the leading cause of disability in the United States among citizens 5 years of age and older. More than 150 million people suffer from MD worldwide, and nearly 1 million people with MD commit suicide each year. MD is nearly twice as prevalent in low-income communities, which generally have diminished access to mental health care.

These tragic statistics stand in opposition to increasing awareness of biological factors that affect depression risk, understanding of depression treatments, and efforts by the pharmaceutical industry to develop depression medications. We now know of multiple brain pathways and neurochemical changes whose underlying molecular foundations can be studied and linked to treatment modalities through genetic studies. However, many patients are still not treated effectively, treatments are slow to take effect, or patients must cycle through a range of treatments to find ones that might work. In order to significantly impact this major healthcare concern and link biological understanding to clinical practice, we need an aggressive, large-scale effort in translational neuroscience focused on depression therapeutics.

For the past three years, VUMC investigators have collected a small cohort of ~150 subjects and have generated phenotypic and treatment response data, as well as DNA samples for genetic evaluation, beyond that generally available in psychiatric studies. With this data set, these investigators, joined by VUMC geneticists, have generated data that suggest that specific genes supporting serotonin, norepinephrine, dopamine, and acetylcholine signaling can influence risk for facets of depression. While as yet underpowered, these data indicate that as few as two genetic variants, applied in tandem, have a >70% success rate at predicting treatment response. These investigators have applied to the NIH to enlarge their study to thousands of subjects. Their goal is to validate the initial hits related to the genetics of depression components and treatment response and to generate a large subject collection to perform multi-gene interaction studies. The latter effort is particularly critical, as no single gene is likely to have a large-enough effect on which to base a treatment protocol.

Thus, a big science project with national repercussions would be to build from this initiative and remove it from NIH budget constraints in order to generate the necessary cohort to establish multi-gene clusters predictive of depression characteristics, including treatment response. This genetic information, akin to developing a biomarker for depression variation and response, could in turn be used to launch a prospective protocol to test the utility of subject DNA evaluation prior to treatment enrollment. The endpoint would be faster, safer, and more effective therapy.

Through well-established collaborations with the Centerstone healthcare network, thousands of MD subjects are eligible to enroll in clinical and genetic evaluation. Vanderbilt can become a major player in the field of psychiatric genetics and capture a substantial opportunity to improve healthcare for our citizens by investing in this initiative and by linking the Centers for Molecular Neuroscience, the Center for Human Genetics Research, and the Departments of Pharmacology, Psychiatry, Biostatistics, and Biomedical Informatics.

Additionally, new brain imaging approaches allow inspection of critical brain regions altered by both genetics and environment in depression. Work has shown that genotype can be linked to how brains respond to anxiety-evoking cues. These data can in turn be used to segregate subjects into treatment groups as well delve more mechanistically into the disorder. With world-class imaging resources at Vanderbilt, this effort would establish links the Vanderbilt Institute for Imaging Science within the framework of a multi-center depression program.

Finally, many disorders that appear in adulthood have antecedents in early childhood. These can arise from environmental challenges (e.g., trauma, separation, illness) or from insidious biological risk factors that help mold the brain during development. Hence, linkage to the Vanderbilt Kennedy Center for Research on Human Development will help penetrate the developmental facets that affect pathways altered in depression, as revealed by basic biochemical and imaging studies. Moreover, we could explore the consequences of early childhood challenges/interventions on genetic factors that influence risk for depression and treatment response.

- 3. Nanovaccines—21st Century Prevention.** Infectious diseases are still the number-one killer worldwide. Vaccines have been the most effective medical interventions to date; however, the easy vaccines probably have all been accomplished. The next decades will require novel approaches for developing the difficult targets. Our objective is to establish an internationally unique multidisciplinary bionanomedicine program for the development of nanovaccines that can be used to protect human and veterinary subjects from infectious diseases. We will capitalize on the explosion of work in the area of fundamental nanoscience at Vanderbilt by combining this area with our experts in vaccine sciences. We will lead the way nationally in the development of next-generation vaccines through development of a unique program that integrates nanoparticle and nanofiber science with virology and immunology sciences for prevention of disease caused by infectious agents. The goal of the program will be to develop a new type of vaccine technology that works at the nanoscale, for precise induction of immunity against germs for which we do not currently have vaccines or viable vaccine strategies.

Recently, unique collaborative work between chemists and physicists in University Central and biologists and physician scientists in the Medical Center has led to a rapid expansion of interdisciplinary research in an area that can be termed Nanomedicine. Nanomedicine is the study, design, creation, synthesis, manipulation, and application of functional materials, devices, and systems through control of matter at the 1–100 nanometer scale (atomic and molecular levels), leading to the exploitation of novel phenomena and properties of matter at that scale that facilitate medical discovery and intervention. Success in this area will require a dedicated consortium of investigators in physical sciences, engineering, biology, and medicine. Fortunately, such a collaborative group has emerged at Vanderbilt, focused on work in the area of immunology and virology. The logical application of this work is to the approach that historically has yielded the greatest benefit to health, namely preventative vaccines.

We will develop, perform preclinical testing, and bring to clinical trials new nanovaccines for difficult-to-prevent viruses that are the major causes of serious respiratory disease. The principal target will be respiratory syncytial virus (RSV), the most common cause of hospitalization of children in the United States and a major cause of death of children worldwide. This new technology platform, integrating both new nanotechnology materials and biological immunomodulating molecules recently discovered through basic immunology studies, will provide a broadly applicable approach to prevention of infections at the mucosa. Other targets that might be amenable to such an approach include all viruses that infect at mucosal surfaces, including influenza and HIV.

A number of additional problems pose attractive candidates for research enterprise big science pilots, and faculty will be invited to submit proposals for these endeavors. For example, faculty are now engaged in an evaluation process to identify a diversity-based big science research project. Projects under consideration include:

- Identifying high-risk genotypes that uniquely predispose African American and Hispanic individuals to obesity and morbid obesity, and implement a targeted behavioral and dietary intervention in young children that is effective for prevention of obesity and its complications in adolescence and adulthood.
- Identifying possible genetic markers in African-American women who deliver premature infants and link this information with environmental, cultural, and behavioral factors. There are already investigators and clinicians mobilizing around this issue and conducting some

preliminary work. The genetic component and the availability to test hypotheses in the Southern Community Cohort Study could strengthen efforts. Reducing prematurity could have tremendous impact on morbidity, mortality, and healthcare delivery expenditures.

- Studying relationships between genetics, socioeconomic indicators, and stress (including perceptions of institutionalized racism) in the prediction of hypertension in African Americans, and use this information to develop a targeted screen for individuals at exceptional risk for hypertension who will benefit from frequent blood pressure screening and pharmacologic intervention at an early age.

Each proposal will be evaluated on a case-by-case basis. We will develop a system for generating potential pilot concepts and will structure a decision-making process that will ensure timely and fair evaluation of these concepts. Once additional big science projects are identified, they will be managed by a dedicated project manager advised by an operations group with representatives from all participating entities. This group will meet monthly to monitor progress. Senior staff in the Office of Research will attend operations briefings to ensure that institutional resources and priorities are aligned to support these projects.

2008 Foundations in Basic Science

Through the Spring and Summer of 2007, the associate vice chancellor for Research and the School of Medicine Dean held sessions open to faculty in both the Medical Center and University Central to discuss the next phase of research enterprise strategic planning for VUMC. From these discussions it was recognized that a majority of the goals of the original (1997) VUMC strategic plan had been successfully met and had greatly enhanced the research and educational environment. The 2006 research enterprise strategic plan put a major emphasis on development of a stronger environment for translational research at VUMC, and important progress in meeting the goals of this strategic plan was already being achieved. We recognized that it was crucial that we maintain strategic balance, particularly given the growing challenges with NIH support for basic research.

One fact that became evident during consideration of the 2006 strategic plan and in the discussions in 2007, was that rather than establishing new individual strategic plans every few years, it was more efficient and would pay greater benefits if existing plans were “freshened” on a regular basis to meet the needs of VUMC in a very rapidly changing world of biomedical research. The need recognized in the 2007 discussion sessions for the first “freshening” of the 2006 strategic plan was a careful consideration of our basic science environment. Six broad categories for consideration were selected for this “freshening:”

- Enhancing Communication
- Sharing Research Information
- Measuring Progress
- Remaining Competitive in Research
- Graduate and Post-doctoral Education
- Enhancing the Reputation of Vanderbilt Research

Faculty volunteers were solicited from across the Vanderbilt campus to serve on committees to consider and discuss these six issues in regards to the basic sciences. A roster of the membership of these committees with designation of the co-chairs for each committee is available in Appendix IV. An outline for this basic science planning effort was developed and broadly distributed with questions to spur the work of the committees:

1. How can communication be enhanced and recognized as a “two way street”?

- a. How can a consistent path of information from administration to faculty best be established without relying purely on faculty meetings or broadcast e-mails? Is the new Research Enterprise website-based newsletter effective, and should it be expanded or modified? Do faculty read this electronic information and if not, why not? Have the two recent “town hall” meetings with faculty investigators been helpful, and if so, what should their frequency and structure/content be going forward? Finally, what other strategies should be considered to enhance communications from administration to faculty?

- b. How can a consistent path of information from faculty to administration best be established that will improve our working environment? Basic science departments have become a focal point of communication and collaboration for many basic investigators primarily appointed in clinical departments. Should the basic science department where their secondary appointment resides be a key communication vehicle? What other avenues of communication would be useful?
- c. How can we improve communication with administrative entities that sit outside the research enterprise (e.g. the graduate school, the registrar, finance, the international office, HR, and other areas under central administration)?

2. We like our “small town” atmosphere - how do we nourish it as we grow?

How can we best establish internal communication about existing, and future collaborative research and projects, faculty accomplishments and challenges, and resources that could be shared between different laboratories, including clones and other reagents? Could web-based search utilities that contain more detailed information on our individual research activities be helpful (Vander-Google)? Does our unit-based seminar series structure need to be reconsidered? What do other research centers do to solve this particular communication problem?

3. How do we measure research progress, including centers and departments?

What are the best strategies to be used for measurement of success in research and research education? What standards should be used and what would be the purpose of such measurements? Does the recent decision by NIH to no longer publish rankings by Departments give us the opportunity to create our own systems? Should we shift the emphasis of evaluating our progress to include measures that more closely reflect output, such as publications and awards?

4. What does VUMC need to do to remain competitive in research?

How do we best anticipate future research directions? Are there new departments, shared core facilities, infrastructure we lack, new Centers, and/or research programs which will enhance our research environment? What do individual faculty feel they need to improve their research? As we identify “gaps” or new directions for our research portfolio and, recognizing there are limited resources, should our basic science departments be working together in a more organized way toward recruiting the most highly sought-after investigators (junior or senior)? Could standing investigator recruiting committees across departments be desirable/beneficial, and if so, how should this addition to our current recruiting strategy work? How could we restructure and/or standardize proportional institutional support for investigator salaries?

5. Do our graduate and postdoctoral education programs meet current and future needs?

Are there changes which should be made in graduate education to enhance its already high quality and perhaps even improve the quality of our students? Are there strategies that can be used to enhance the quality of our already excellent group of postdoctoral trainees? Should we re-evaluate our approach to supporting faculty salaries for teaching?

6. How can the reputation of Vanderbilt research programs and faculty be enhanced?

How can our research excellence in specific areas be made more visible at the national and international level? How can we increase our scientific impact? In the last 5 years, we have made excellent progress with expanding the number of IOM members on the medical faculty, but little or no progress has been made with organizations primarily focused on basic science, such as the NAS and HHMI. While the Discovery Lecture series is now bringing many such individuals to campus, how could we make more rapid progress with expanding our membership in these organizations? Should we have a standing “awards” committee that would identify specific candidates in advance, and work with them to build their portfolio and national connections? Are there other approaches we should consider? How might joint recruitment between Departments/Centers be used to increase our success in these areas?

The six committees met and interacted through the Fall of 2007 and the Spring of 2008 and solicited input from their faculty colleagues across the campus. They developed and honed a preliminary set of must-do's for the basic sciences based on these deliberations and interactions. This preliminary set of must-do's was vetted with faculty from across the campus through two Town Hall meetings in late Spring 2008, and through an open blog available for comments from anyone at Vanderbilt for a period of three weeks after the Town Hall meetings. From this careful, extended discussion amongst the faculty, detailed original must-do proposals from each committee were completed. These versions are fully contained in Appendix III. A further series of meetings were held in the summer/fall of 2008 with the committee leaders, and the detailed proposals were distilled into a core set of prioritized objectives. The prioritized must-do's targeted to the basic sciences include:

Enhancing Communication

MUST DO's:

1. Develop a suite of mechanisms to facilitate effective bidirectional communication between basic science investigators, department chairs, and central administration.
2. Consolidate, integrate and expand support for web-based and email communications across the entire institution.
3. Develop ways of minimizing regulatory burdens on faculty time/effort through expanding user-friendly compliance systems and direct engagement of faculty in strategies to manage compliance.

Sharing Research Information

MUST DO's:

1. Develop an in-house searchable database that contains VU specific research information
2. Develop new infrastructure and administrative models to allow greater coordination and support for research, and tailored to the needs of basic scientists.

Measuring Progress

MUST DO's:

1. Institutional leaders/Department Chairs and Institute/Center Directors must define excellence and measures of progress in terms of what is produced, beyond standard measures of NIH revenue.

2. Preserve the best aspects of our institutional culture, while increasing breadth and amounts of investment in individual basic scientists as well as innovation and new directions in basic research.

Remaining Competitive in Research

MUST DO's:

1. Invest in faculty with basic support to maintain flexibility of effort, and expand investment in high-risk, highly innovative investigator-initiated projects.
2. Develop policies and support mechanisms for the maturation of trans-institutional centers and institutes.
3. Identify mechanisms to inspire and develop the careers of our best mid-career faculty.

Graduate and Postdoctoral Education

MUST DO's:

1. The umbrella programs that serve as entry points into Ph.D. granting programs should receive centralized funding directly from the administration
2. The IGP should be subjected to both internal (short-term; within months) and external (within the year) review to critically assess IGP organization, IGP administration and IGP Core course content and duration. As part of the evaluation of course content, a set of well-defined core competencies should be developed for which all IGP students will be responsible.
3. Establish a liaison capability between the Graduate School and the International Office with the goals of forming alliances with international universities to recruit the best graduate students and postdoctoral fellows, expand Vanderbilt's visibility, and facilitate scholar exchange programs.

Enhancing the Reputation of Vanderbilt Research

MUST DO's:

1. Create an Awards Committee that collaborates with department chairs and other Vanderbilt leaders to identify, mentor and promote Vanderbilt faculty for appropriate honors, awards and distinctions.
2. Create a process for sponsoring national and international symposia at Vanderbilt.
3. Develop a comprehensive and appropriately targeted strategy to promote national awareness of the achievements of the Vanderbilt research enterprise
4. Commit funds and create mechanisms for targeted joint recruitment by Departments/Centers of internationally recognized senior faculty who are conducting the highest impact research.

2006: Personalized Health and Healthcare Must Do's

The goal of Personalized Health and Healthcare at VUMC is to integrate fundamental discovery spanning the physical, quantitative, and biological sciences with clinical investigation to increase our understanding of disease processes and therapeutic interventions. Specifically, we seek to advance individually tailored healthcare based on a patient's molecular, environmental, and socio-economic context. Beyond the five overarching objectives, six additional initiatives (“must do's”) were judged fundamental to achieving success with Personalized Health and Healthcare:

1. Expand our “omics” strength in metabolism and lipid arenas
2. Strengthen our image analysis and classification core
3. Create VUMC “standardized” descriptors for all types of data at the collection stage to permit data mining and linkage across platforms
4. Expand existing cohort trials to include diseases other than cancer and establish infrastructure to allow broader access to samples and data arising from cohort and other clinical trials
5. Establish a human investigation data coordinating center capability for multicenter trials
6. Create de-identified clinical databases and marry them to routine blood sampling (DNA Databank)

Together, these tasks will help link the immutable elements of clinical information (gender, family history, DNA sequence) with data from imaging, proteomics, and microarray platforms that change over time. This will allow VUMC investigators and research centers to share searchable, real-time data from basic and clinical research to create advances in Personalized Health and Healthcare that ultimately will transform healthcare.

MUST-DO TASK 1

Expand our “omics” strength in metabolism and lipid arenas

Vanderbilt's lipidomics center—one of six in the United States funded by NIH under the Lipid MAPS Consortium— identifies and measures lipids in a cell. As part of the Mass Spectrometry core, the center uses high throughput technology to create “lipid profiles” that help refine our molecular understanding of disease and add to the knowledge being accumulated by gene arrays and proteomics. Lipidomics also may lead to the discovery of new pathways that serve as drug targets for diseases such as atherosclerosis, cardiovascular disease, and cancer. Lipids themselves are becoming important new drug targets. Vanderbilt is one of the few institutions in the country with investigators simultaneously pursuing gene expression *via* microarrays, proteomics, and lipidomics. By combining these technologies, we are in a unique position to understand human diseases at the molecular level and improve patient diagnosis and prognosis.

Vanderbilt's investment in mass spectrometry— along with our strengths in analytical and patient-oriented lipid biochemistry—positions it in the vanguard of lipidomics research worldwide. In fact, the birth of lipidomics is intimately associated with Vanderbilt. Thus, few if any other institutions have the opportunity to lead in this area. Development of a dedicated lipidomics facility within our Mass Spectrometry Research Center will propel this field forward at VUMC. Combined with our strengths in mass

spectrometry and early drug and drug-target discovery, an expanded lipidomics program with additional dedicated faculty and clinical resources will provide unprecedented opportunity for discovery of early biomarkers of disease and therapeutic targets in lipid membranes.

MUST-DO TASK 2

Strengthen our image analysis and classification cores

Vanderbilt's Cell Imaging Core provides optical and electron microscopes, expert guidance in confocal and wide-field microscopy, sample preparation services, and associated image analysis, processing, and output systems. More than 200 research groups use the Cell Imaging Core, which also offers training in routine and advanced digital imaging.

The Vanderbilt University Institute of Imaging Science (VUIIS) develops new imaging methods and applications in cancer, neuroscience, metabolic disorders, cardiovascular disease, and other areas. It operates state-of-the-art facilities for imaging research at all scales.

The Center for Human Studies, a component of VUIIS, provides facilities and support for structural, metabolic, and functional imaging of human subjects. Researchers may access extensive clinical imaging resources, including CT, PET-CT, MRI and ultrasound imaging. Equipment provides continuous physiological monitoring of subjects, generates and delivers stimuli, and monitors and records responses during brain function studies.

The Center for Small Animal Imaging (CSAI), which also operates under VUIIS, is dedicated to small animal research for a variety of applications. It offers high-field magnetic resonance imaging and spectroscopy, small animal high-resolution X-ray computed tomography, nuclear imaging techniques, including microPET and microSPECT, high-resolution ultrasound, and optical imaging. The CSAI is staffed with equipment operators, animal technologists, instrumentation engineers, and a computer systems manager.

Recognizing that these shared resources are vital to institutional success in Personalized Health and Healthcare, VUMC is investing heavily in their expansion. A new building is under construction to house the personnel and laboratories of VUIIS in a single dedicated facility that will be completed in summer 2006. The Center for Human Studies will receive a 7T MRI scanner in early 2006, and the Center for Small Animal Imaging will receive a dedicated MRI imaging system in early 2006. However, more investment must be made, particularly in the expansion of bioinformatics support for image analysis in these cores. Both hardware and bioinformatics faculty and staff expansion will be needed to make the capabilities of these cores fully available to VUMC faculty.

MUST-DO TASK 3

Create VUMC "standardized" descriptors for all types of data at the collection stage to permit data mining and linkage across platforms

Integral to our goal of Personalized Health and Healthcare are databases that may be linked, merged, and mined for clinical information and molecular data. For example, one database may contain information on banked tissues, one may hold information about the patient or animal from whom the tissue came, and one may contain microarray and proteomic data about the tissue.

In order for these data to be searched, each element must contain a unique, standardized identifier. With tissue, for example, the identifier would remain with the tissue sample as it transited from surgical pathology to microarray or proteomic studies through data analysis.

We must develop a standardized descriptive nomenclature for information entered in these linked, searchable databases. This work is vital for data storage and mining because researchers from different disciplines may describe the same phenomenon differently. For example, a cancer researcher might

search a database for “metastatic carcinoma to the lymph node,” while her pathologist colleague might search for “lymph node with metastatic carcinoma.”

Our challenge is to define a standardized vocabulary that is flexible and easily searchable while maintaining the security and confidentiality of patient information, as well as including images with searchable data sets.

MUST-DO TASK 4

Expand existing cohort trials to include diseases other than cancer and establish infrastructure to allow broader access to samples and data arising from cohort and other clinical trials

The VICC, in coordination with Meharry Medical College, and the International Epidemiology Institute have begun to address gaps in population-based cancer research through the Southern Community Cohort Study (SCCS). Funded by the National Cancer Institute, the study is interviewing 70,000 African American and 35,000 non-African American residents of the South about health and lifestyle. Participants donate a blood, mouth cell, and/or urine sample, then will be followed over time, possibly for decades. Health outcomes will be monitored to explain disparities in common and rare cancers and to help in preventing cancer. DNA and serum samples will be extracted for molecular epidemiology studies.

The Office of Research will work with the VICC to expand existing cohort trials such as the SCCS to include other diseases prevalent in these patients, such as diabetes. These cohort studies will provide crucial information that will become part of meaningful models for treating and preventing these diseases. While this information is vital to researchers seeking improved methods of diagnosis, treatment, and prevention, it is of limited usefulness if data access is limited and cumbersome.

As part of must-do task number 4, we will create the infrastructure and IT support to allow broader access to information arising from VUMC cohort trials. This infrastructure will include expansion and improvement of our mass spectrometry core.

MUST-DO TASK 5

Establish a human investigation data coordinating center capability for multicenter trials

The previous four must-do tasks are designed to provide accessible data in ultra-large, aggregated databases. Researchers will use these data in hypothesis-driven clinical trials that ultimately will yield healthcare personalized to individual patients based on their genetic, ethnic, socio-economic, and environmental backgrounds. However, this information will be of limited use if it is inaccessible, scattered throughout VUMC’s research centers and individual clinical investigators’ databases. Moreover, in many cores, clinical data will arise from several participating institutions. Therefore, the Departments of Biostatistics and Biomedical Informatics will establish a Data Coordinating Center (DCC) with the infrastructure and expertise to streamline the process of data gathering, aggregation, analysis, storage, and access to data from multiple sites.

To be competitive as a DCC in grant applications, we must develop the following components:

- **Statistical expertise.** This includes a doctoral statistician as PI. A second doctoral statistician would provide backup. Both would be involved in design and reporting. A master’s level statistician and statistical programmer would complete the team.
- **Clinical expertise.** This includes Vanderbilt physician scientists knowledgeable about specific research grants.
- **Data management.** This includes a study coordinator to design forms and write the manual of operations. The coordinator will be the liaison with the clinical center study coordinators to answer questions and manage data queries.
- **Application development.** This includes systems programmer analysts to design and create the database.
- **Systems management.** This involves infrastructure needed to support the computing operation used in multicenter studies, including hardware and software.

- [Cost effectiveness and medical decision analysts.](#)
- [Administrative support and other personnel.](#) This includes a financial analyst, a project manager, a regulatory specialist, a web designer, and statisticians with methodological expertise in longitudinal methods, clinical trials, or other areas. We have computing expertise in the School of Medicine, but this will need to be expanded.

DCC activities for each phase of a study would include:

- [Phase I:](#) Protocol development; study design, measurements, and schedule; sample size and power; analysis methods and plans; randomization scheme; forms and database development; quality assurance procedures; Manual of Operations; informed consent and IRB issues; central facility arrangements; ancillary studies development; recruitment materials; training; logistical and administrative support (all phases).
- [Phase II:](#) Monitor recruitment; data acquisition and patient management; internal and external QC; centralized measurements and review; interim analyses for stopping trial; acquisition of stored biological specimens.
- [Phases II and III:](#) Reports for clinical centers, steering committee, DSMB, and sponsor; development of new statistical methodology; analyze ancillary studies; review protocols for and release of stored biological specimens; analysis, writing, and review of abstracts, presentations, and publications.
- [Phase III:](#) Analyze and prepare final results; individual patient report summaries; public-use database archiving data.

Several items need to be in place before making a successful DCC grant application:

- A senior biostatistician with experience in clinical trials and leading DCCs.
- A fully compliant operating computing and database system that can support large-scale multicenter studies.
- Computing and applications development personnel with experience in supporting clinical research and DCCs.
- A Director of Computing with an NIH-supported DCC track record to help develop computing infrastructure and assist in writing grants.

MUST-DO TASK 6

[Create de-identified clinical databases and marry them to routine blood sampling \(DNA Databank\)](#)

A wide body of knowledge exists on the rarer, single gene diseases such as Huntington's chorea and cystic fibrosis. But common diseases in humans, such as diabetes, Alzheimer's, cancer, Parkinson's, and heart disease, are not caused by a variation within a single gene; instead, the onset, progression, severity, and response to therapy of many common diseases may be influenced by complex interactions among multiple genes as well as environmental factors. By studying components of DNA that include a variant associated with a given disease trait, researchers may begin to find sets of gene variations associated with common diseases. Because these diseases have multiple genetic and environmental contributions, large numbers of samples are necessary to establish these linkages, well beyond the capability of any single investigator or group of investigators.

With the objective of creating the large-scale resource necessary to support this work, VUMC is working to synthesize a de-identified clinical database from its electronic medical record, and marry that information to DNA sequence extracted from routine blood sampling to provide VUMC investigators with the most complete resource for detecting unknown or unexpected molecular-phenotypic relationships for hypothesis generation. Work to establish the Vanderbilt DNA Databank is now underway, and efforts to collect DNA from nearly 70,000 patients entering Vanderbilt Hospital and Clinic each year are scheduled to commence before the end of fiscal 2006. Vanderbilt's sophisticated, scalable clinical information systems (VPMIS, STAR, WIZ) make it possible to contemplate large-scale linkage between DNA sequences and clinical information. Advanced strategies for data mining and data de-identification (stripping clinical data of all personal identifiers while maintaining integrity of the phenotypic information) must be tailored to this task, requiring additional investment in both basic and clinical bioinformatics. This

vision plays well to Vanderbilt's established infrastructure and leading reputation in basic and clinical pharmacology, as a natural focus of these efforts is to identify genomic markers that would allow drug therapy customization. This database will allow our investigators to compete more effectively for public and private funding for their research.

2006: Therapeutic Discovery & Translation

Must Do's

The goal of our Therapeutic Discovery and Translation theme is to establish a broad, cohesive drug discovery program that will leverage our extensive basic science programs aimed at target identification and that will identify novel agents that may be developed into drugs to cure disease and alleviate suffering. Such a program will position Vanderbilt at the forefront of academic institutions engaged in drug discovery and development and could lead to valuable license and royalty opportunities for the research enterprise.

The must-do tasks for Therapeutic Discovery and Translation are:

1. Expand our vivarium facilities and animal core services, including histopathology
2. Link the Center for Molecular Toxicology to our expanding program in therapeutic discovery and translation
3. Develop an antibody therapeutics program
4. Support and expand our small-molecule drug discovery program
5. Create infrastructure that facilitates links to industry partners

MUST-DO TASK 1

[Expand our vivarium facilities and animal core services, including histopathology](#)

Due to extraordinary growth in the research enterprise, we are rapidly approaching maximum capacity in our vivaria. Over the next 2.5 years, we will complete design and construction for a new facility serving large and small animals. The new vivarium will include state-of-the-art animal housing, a surgical suite, core facilities, and procedure rooms. It will be designed based on the animal models required to support faculty research, will meet all current compliance guidelines, and will provide surgical procedures and Division of Animal Care support for the investigation of animal pathology. We will also expand our rodent behavioral core facilities. To manage colonies, investigators will use information technology that will allow desktop communication with the vivaria.

MUST-DO TASK 2

[Link the Center for Molecular Toxicology to our expanding programs in therapeutic discovery and translation](#)

A tremendous opportunity exists for research in molecular toxicology, particularly as applied to pharmaceuticals. Failure in toxicity and safety assessment is a major hurdle in getting new drugs to market and keeping them in use. Vanderbilt is well positioned to make important contributions in this area, and an organized program will complement other initiatives, including biomarker development, Personalized Health and Healthcare, and increased interactions with the pharmaceutical industry.

We plan to expand the Center for Molecular Toxicology, now heavily focused on environmental toxins, into an umbrella center with five or more components that will add breadth to the existing program and interact and mesh with other VUMC efforts, including the metabolism and pharmacogenomics programs in the Division of Clinical Pharmacology and the Oates Institute. The center will focus on developing research and training programs in toxicology and drug metabolism and could become a conduit to interaction with industry groups. This new structure will require recruitment of faculty specializing in the mechanisms of toxicity and pharmacogenomics.

MUST-DO TASK 3

Develop protein-based therapeutics research

Our efforts to develop protein-based therapeutics research encompass three areas: 1) a protein expression/purification core; 2) expansion and modification of our existing molecular recognition core; and 3) antibody therapeutics program. These are addressed in detail below.

1. Protein Expression/Purification Core

The Protein Expression Core will facilitate expression, purification, and characterization of proteins and protein complexes. It will develop new technologies, emphasizing high throughput production of pure proteins using automation, and feeding pipelines to real-time analyses of protein reagents. It will focus on protein expression in bacteria, yeast, insect and mammalian cell lines, along with complementary cell-free protein synthesis techniques. A series of interchangeable, efficient, and nonproprietary “ligation-independent cloning” vectors will be used for efficient shuttling of genes and gene fragments between vectors for different expression strategies. Efficient protein purification protocols will be developed utilizing the latest state of the art technologies. The core will also provide expertise and instrumentation to ensure that purified proteins are properly folded and active. Since the user base is expected to be idiosyncratic in its needs, the core will respond to individual requirements through expertise and support of well-accepted, versatile technologies.

The core will evolve and adapt the most useful methods for its users. In addition, new technologies developed in expert laboratories will be tested then incorporated for general use by the core. These will include: 1) protein evolution and combined screening to enhance protein solubility; 2) automated microtiter-based screens of protein homologs and variants for the identification of experimentally tractable versions of otherwise insoluble or nonfunctional proteins.

Finally, the core will serve as an interface between users and the utilization of their reagents directly for testing directly as protein therapeutics or for pre-clinical studies *in-vitro* or *in-vivo*. For example, the core will greatly facilitate pursuit of macromolecular structure determination by NMR and X-ray crystallography as well as *in vitro* screens for small molecule modulators. These areas are poised for increased usage due to technological advances and extensive financial investment. The common underlying need for purified proteins makes the Protein Expression Core a natural conduit to the utilization of a range of powerful new methodologies designed to develop protein-based therapeutics.

2. Expansion/modification of our existing molecular recognition core

Human diseases can be treated with a variety of therapeutic agents, including low molecular weight drugs and proteins such as antibodies. There are currently 21 commercially available antibody-based therapeutics and several hundred additional products under development, with the majority used for treating cancer and autoimmune disorders. While small-molecule therapeutics remains attractive, their introduction into the consumer market has slowed as the pharmaceutical industry has been forced to address issues of drug non-specificity and toxicity. Additionally, minor changes made to small molecules to improve their potency can result in adverse effects on their biological activity, specificity, or toxicity. In contrast, because antibodies are relatively large in size, they can be genetically engineered to increase their biological activity without sacrificing their specificity and affinity or increasing toxicity. These characteristics, combined with rapid advances in immunology, molecular biology, phage display, high throughput screening, and protein production and purification methodologies, have catapulted antibody therapeutics into a central position in human therapeutics.

A majority of the lead biological molecules targeted for therapeutic intervention are discovered through NIH-funded research, and Vanderbilt is one of the nation's fastest growing NIH-funded medical research centers. Biomolecules identified through Vanderbilt investigator-initiated research represent a large potential source of targets for antibody-based therapeutics. The Vanderbilt Molecular Recognition Unit (MRU) has developed hybridoma monoclonal and phage-displayed recombinant antibodies for research, diagnostic, and therapeutic use. The MRU utilizes large rodent and human phage antibody libraries and high throughput screening to rapidly interrogate biomolecules and identify antibodies that have therapeutic potential. Because of this capability,

Vanderbilt is uniquely poised to rapidly identify, patent, and license antibodies and the biological sites they recognize for therapeutic use.

3. Antibody therapeutics program

Antibodies are attractive targets for therapeutic and diagnostic development. Sales for therapeutic antibodies in 2002 reached \$5.4 billion, and projections suggest sales as high as \$16.7 billion by 2008. Vanderbilt has a state-of-the-art antibody generation facility that produces both monoclonal antibodies and phage-displayed single-chain antibodies. Phage antibodies (scFv) can be rapidly selected and prioritized by their affinity and ability to bind specifically to surface receptors. These single-chain antibodies can be converted into humanized monoclonal antibodies for direct therapeutic use or conjugated to other therapeutic agents such as radionuclides or drug delivery systems such as nanoparticles and liposomes. These technologies also complement recent initiatives in nanotechnology in that Quantum Dots can be conjugated to antibodies and used for prioritization of antibodies and microscopic imaging of immunostaining.

MUST-DO TASK 4

Support and expand our small-molecule drug discovery program

While Vanderbilt has a strong infrastructure that could support drug discovery, our existing capabilities and previous investments will not promote drug discovery or product development without further investment in a strategic, focused effort. We must build an early-stage pipeline of research projects aimed at developing novel therapeutic strategies, then focus intense effort on further development of those projects with the highest likelihood of success.

This effort must engage the expertise of our faculty at multiple levels. An approach would be a Vanderbilt Drug Discovery Advisory Board, with members from departments and centers as stakeholders in the enterprise. Novel, exciting targets are routinely discovered and disclosed to technology transfer within the VUMC research enterprise. Members of the Advisory Board would work with the investigator to determine the desirability of developing high throughput assays in the VICB to identify a potential therapeutic compound. The Board would establish milestones and go/no go experiments that must be met in order for a project to move forward.

Meeting milestones will not guarantee that a project moves to the next stage. Projects will be evaluated by the Advisory Board, and those most likely to lead to marketable products will be chosen for further investment. As projects succeed at the earliest stage, those with the highest likelihood of success will be chosen for further investment through database mining, medicinal chemistry, and pharmacokinetic analysis.

We must identify facilities for this advanced development and analysis either at Vanderbilt or through partnerships with academic centers already developing these resources, such as St. Jude's Children's Research Hospital, or with industry. We could leverage established collaborations between VUMC and biotechnology companies having expertise in chemical synthesis and pharmacokinetic analysis. Finally, early studies in humans could be developed through the expertise of faculty in the Oates Institute and the GCRC.

If early medicinal chemistry suggests that a chemical class has therapeutic potential, further investment will be required to refine compounds for partnering or licensing with biotechnology companies. At each step, the Advisory Board will be involved with investment decisions and experiment identification. This effort would require institutional support to:

Recruit additional faculty with expertise and interest in areas critical for establishing the drug discovery pipeline, with a view to strengthening key technical capabilities. A small-molecule drug discovery program will require support to recruit new faculty members with expertise in critical areas. Individuals must be highly committed to working in a team effort aimed at development of novel therapeutic agents. We anticipate needing faculty in four areas. The exact mix of individuals will depend on a number of

factors, including recruitment efforts of other departments and centers. Below are examples of the types of individuals needed to support drug discovery at Vanderbilt.

- *Medicinal Chemists.* Chemical optimization of compounds advancing through the drug discovery program will require expertise in Medicinal Chemistry. We will target individuals skilled in drug discovery with rapid analog parallel synthesis as an approach to build small libraries of compounds around initial HTS hits. We will also target individuals who have considerable expertise and commitment to an area of biology that complements strengths of Vanderbilt biologists who are engaged in drug discovery.
- *Behavioral/In vivo Neuropharmacology.* Drug discovery efforts will focus on development of novel approaches to treat CNS disorders, requiring expertise in behavioral pharmacology. We will recruit an individual with the expertise needed for development of CNS active compounds, including *in vivo* microdialysis, *in vivo* and *ex vivo* radioligand binding, and/or *in vivo* imaging in small animals.
- *Cellular/molecular translational biologists.* We need to increase the number of basic biologists who have a *primary* commitment to drug discovery and who are willing to commit the majority of their laboratories' efforts to translational science. This includes individuals with expertise in assay development and high throughput technologies. An initial focus for this recruit will be the cancer arena, through collaboration between the Oates Institute and the VICC.
- *Drug Disposition.* A major goal for each drug discovery effort will be to develop proof-of-concept compounds that can be used for *in vivo* testing of novel approaches to therapeutics. Also, we will endeavor to develop lead compounds that can serve as a basis for full medicinal chemistry efforts aimed at advancing compounds to clinical development. To accomplish this, it will be essential to evaluate the pharmacokinetic properties and major metabolic routes of lead compounds. Through the Division of Clinical Pharmacology, we will recruit an individual who has the expertise required to oversee the pharmacokinetic analysis of compounds developed at Vanderbilt.

Move the highest-priority programs through later-stage development to a point where they are marketable as external licensing and partnering opportunities. At steady state, we will develop 2–3 high-priority projects per year to a stage where they are viable projects for licensing or partnering with pharmaceutical and biotech companies. This will require support from a full-time individual devoted to identification of potential partners and negotiation with pharmaceutical and biotech companies. The Office of Research has recruited a physician scientist experienced in drug discovery and industry who will begin 11/1/05 and will work with the VU Office of Technology Transfer and Enterprise Development to shepherd these efforts (see below).

MUST-DO TASK 5

Create infrastructure that facilitates links to nonprofit and industry partners

As we embark on efforts to dramatically expand our work to bring molecules further in the therapeutic development process than ever before, opportunities for faculty to partner and license their intellectual property (IP) will escalate. The Office of Technology Transfer and Enterprise Development (OTTED) already serves faculty throughout the entire university in these efforts. Given an expanded focus on IP around therapeutics in the Medical Center, even greater effort is needed to establish links between the VUMC research enterprise and outside entities for strategic partnerships, sponsored research, and joint ventures. One or more individuals closely affiliated with OTTED and VUMC, who possesses a strong background in industrial drug development, basic science, and clinical medicine, could be very helpful if they became deeply familiar with the VUMC scientific enterprise with respect to both intellectual capital and intellectual property. Such an individual could leverage that knowledge to help us expand outside relationships as stated above.

Hence, in partnership with OTTED, the VUMC Office of Research has created a new position of Assistant Vice Chancellor for Research that will relate closely to OTTED. This individual will work with executive faculty and all center directors to help develop their IP with a view to communicating their discoveries to industry. In addition, this individual will relate closely to the Director of Strategic Planning in the Office of Research, to ensure optimal communication relating to our big science initiatives and our many multi-

investigator NIH awards with a view toward leveraging these efforts into outside partnership opportunities.

A major barrier to faculty efforts to perform basic and clinical research with industry has been the complexity of contracting and IP arrangements. These negotiations often take many months, and the impetus for scientific efforts may become stale as negotiations ensue. To reduce or eliminate this barrier, VUMC OTTED is working to negotiate Master Research Agreements with several pharmaceutical and biotechnology companies. These Agreements define most IP, materials transfer, and indemnity terms for a wide range of research such that individual projects and their budgets can be appended to the Master Agreement. Once the terms of the Master Agreement are defined, new studies can be initiated within weeks. The new Assistant Vice Chancellor (AVC) will be responsible for assisting OTTED in identifying new partners for VUMC Master Agreements and for facilitating negotiation of agreement terms. Once these agreements are executed, the AVC will bring together groups of interested faculty and key contacts at the company to assist faculty in taking full advantage of the opportunities afforded by the Agreements. These Agreements will provide a source of revenue for research outside the traditional NIH framework and have the potential to accelerate VUMC faculty efforts to turn their discoveries into royalty-generating licenses. Developing relationships with industry sponsors to initiate basic or clinical research also creates a framework for the eventual “hand-off” to the company for converting the IP into a marketable product.

The new AVC position will also take a leadership role in helping shape our scientific relationships with other research partners in the region, such as Oak Ridge National Laboratory, St Jude Research Children’s Hospital, and the University of Tennessee. The goal will be to create networking opportunities for joint activities that could be appealing for funding by industry and nonprofit agencies. Tennessee has lagged behind many states in developing vehicles for biotechnology development. Although a small number of biotechnology “parks” are under development, such as the Cool Spring Life Sciences Center in Franklin (a joint project with VUMC), it is a formidable challenge for small, emerging companies that arise from VUMC or other Tennessee research institutions to identify the multiple rounds of venture capital necessary to develop their discoveries into successful companies. Working with OTTED and Tennessee research partners and state and regional economic development programs, such as the Tennessee Office of Economic Development and the Nashville Chamber of Commerce, the AVC will spearhead VUMC efforts to identify local, state, and federal funds. These funds will support VUMC faculty with marketable IP as they form new companies aimed at developing their discoveries for the marketplace. In addition, the AVC will work with the Vice Chancellor for Health Affairs, the Associate Vice Chancellor for Research, and OTTED to identify private venture capital support where such arrangements are desirable.

2006: Public Health and Healthcare Must Do's

Rather than create a school of public health, over the years Vanderbilt has created departments, centers, and programs that address public health issues. Now that we have these entities working on various public health issues, we must organize them for optimal synergy and communication. We also must use clinical information technology to accelerate advances in public health and healthcare. These advances, when integrated with our molecular and bioscience discovery programs, can help translate breakthroughs from the bench to diverse patient populations in an efficient, safe, and cost-effective manner. Listed below are must-do tasks that will support these goals.

1. Create an overall “institute” to enhance internal coordination among related areas
2. Establish a new center with research focused on the health and healthcare problems of our aging population
3. Establish a broader range of activity in epidemiology, including a Ph.D. program, as well as an M.S. and Ph.D. program in biostatistics
4. Address diversity/disparities by increasing minority research faculty hiring and developing large-scale, diversity-based research projects *via* the Vanderbilt/Meharry Alliance
5. Establish focused international partnerships, with a priority of expanding our research program in global health
6. Research Quality Assurance efforts, EBM pathways, QI dashboards

MUST-DO TASK 1

Create an overall “institute” to enhance internal coordination among related areas

The deans of schools of medicine and public health reached a driving conclusion in the 1990s: Close the chasm between the two schools. The proposed Vanderbilt Institute for Medicine and Public Health responds to this need. Three forces fuel this change. First, solutions to problems facing medicine and public health will require better engagement with other disciplines throughout the University. The Institute will contribute to the translation, implementation, and continued evaluation of appropriate, tested, valuable content. This work will require interdisciplinary approaches that will include the humanities, engineering, management science, psychology, anthropology, sociology, ethics, education, epidemiology, statistics, medicine, nursing, and basic biomedical sciences. This Institute will advance understanding of the effect of public policies and payment structures on healthcare delivery, outcomes, and evaluation. It also will advance knowledge of methods for defining and measuring the performance of operational and clinical processes of care. The Institute would nurture University-wide efforts at the intersection of medicine and public health. Its mission is to improve personal and public health through discovery, training, and service programs aimed to protect against threats to health, promote healthier living, improve the quality of health services, and prepare leaders to advance health and healthcare.

Institute Organization and Governance

The Institute will be the knowledge discovery arm of a tripartite structure where the Center for Better Health will work collaboratively with the Institute to accelerate change in healthcare management, and where the Center for Evidence-Based Medicine and the Office of the Chief Medical Officer will be the responsible for implementing process improvements in healthcare at VUMC.

The Institute will have a central administrative staff, initially consisting of a Director, Associate Director(s), Administrative Officer, and additional staff to support grant applications, grants management, fund raising, and general faculty support. Central Institute administration will oversee common support structures among its centers and serve as a communication and coordination device to promote each of the center's efforts. It will administer a core budget, assist each center with an annual budget for their work, facilitate extramural funding from multiple sources, and maintain central communication links to its environment, both within and outside the University. Central administration will provide vision, identify new opportunities for work, create new centers when appropriate, and facilitate faculty recruitment.

The work of the Institute will be conducted through its Centers. Initial centers are described below, some already established and others to be established as the Institute is formed:

- The Center for Health Services Research
- The Center for Epidemiologic Research
- The Center for Medicine, Health, and Society
- The Joint Center for Nursing Research
- The Institute for Global Health
- The Institute for Community Health
- The for Biomedical Ethics and Society
- The Center for Quality Aging

Center for Health Services Research

The Center will operate through six research programs:

- The Clinical Epidemiology and Outcomes Research Program
- The Chronic Disease and Molecular Epidemiology Research Program
- The Clinical Economics and Decision Sciences Research Program
- The Health Behavior and Education Research Program
- The Clinical Improvement and Operations Research Program
- The Health Policy Program

As these programs grow, it is anticipated that some will emerge into separate centers. Space, core funding, and recruitment will shape the depth and breadth of these programs and their rate of growth toward separate Center status.

The Center for Health Services Research also includes a number of specialty or topic-based programs. These include: the Perioperative Outcomes Research Program (supported through Anesthesiology), the Multicenter Orthopedic Outcomes Network (supported through Orthopedics), the Pediatrics Health Services Research Program (supported through Pediatrics), the Center for Improving Patient Safety, the Center for Education and Research in Therapeutics, the Vanderbilt Health Promotion and Disease Management Center, the VA Center for Patient Healthcare Behavior, the VA Geriatric Research Education and Clinical Center, the VA Clinical Research Center of Excellence, the AHRQ T32 training program in health services research, and the VA Quality Scholars Program.

Center for Epidemiologic Research

To foster a broad collaboration in epidemiologic research across various departments at VUMC, we propose to establish a Center for Epidemiologic Research (CFER). The proposed center will focus on developing research infrastructures, recruiting new faculty, and providing training opportunities for graduate students and research fellows. A major priority of the Center will be the development of a Ph.D. program in epidemiology (*see page 54*). Proposed services include a survey core, a data analysis core, and a laboratory core to support population-based studies. These shared resources would:

- Provide technical support for the design of survey questionnaires and computer databases for field operations
- Implement mail and telephone surveys, including protocols for identifying and recruiting appropriate subjects for epidemiology studies

- Computerize and clean survey data and generate progress reports
- Assist investigators in statistical analysis of epidemiologic research data

[The Center for Medicine, Health, and Society](#)

The Center for Medicine, Health and Society was created in 2003 within the College of Arts and Science at Vanderbilt University. Its mission is to link the humanities and social sciences with the health professions. It has more than 100 affiliates from all nine schools and colleges of the University. It offers an undergraduate program (minor and contract major in Medicine, Health, and Society) and sponsors seminars, workshops, lectures, and conferences. Faculty from the center will be integral leaders and collaborators on projects of direct relevance to the Institute, including patient and provider behavior, defining and measuring patient-centered outcomes, examining ways to improve processes and structures, and evaluating the impact of new patient-centered approaches to care.

[The Joint Center for Nursing Research](#)

The focal point of scholarship at the School of Nursing is the Joint Center for Nursing Research (JCNR). Although research and scholarship activities occur throughout the school and are woven into all aspects of academic life, the JCNR is the central resource, repository, and facilitator of faculty, student, and nursing scholarship. Its mission is to facilitate scholarly activity and promote new knowledge and improved care delivery to the community and the nation. It achieves this mission through established relationships between the School of Nursing, the University and hospitals, and healthcare agencies affiliated with it. Faculty from the JCNR will be integral leaders and collaborators on projects of direct relevance to the Institute, including health policy, effective design and deployment of the nursing workforce, improving the structures and processes of care to facilitate higher-quality and lower-cost care, better teamwork among the health professions workforce, defining and improving patient-centered care, and patient and provider behavior.

[The Institute for Community Health](#)

The Institute for Community Health is a collaboration between Vanderbilt University and Meharry Medical College that promotes and conducts health services and public health research and training with a focus on eliminating health disparities. The Institute is supported by a grant from the NIH that provides funding for four cores: administration research, shared research resources, education and training, and community outreach. The Institute coordinates activities with the new Center for Optimal Health at Meharry. It is supported through a NIH training grant that provides faculty support, trainee stipends, and tuition support. This program has created a new Master of Science in Clinical Investigation at Meharry that shares courses with Vanderbilt's MPH and MSCI degrees. Faculty from this Institute will be leaders and collaborators on projects of direct relevance to the Institute for Medicine and Public Health, with a special focus on eliminating health disparities.

[The Center for Biomedical Ethics and Society](#)

The Center for Biomedical Ethics and Society (a merger of the Center for Clinical and Research Ethics and the Center for Genetics and Health Policy) is currently undergoing a strategic planning process to guide its future. The combined Center will provide coordinated communication, research development, and support structures for each of the current centers. Faculty from the center will be integral leaders and collaborators on projects of direct relevance to the Institute, including health policy, clinical economics and medical decision-making, patient-centered improvements to the process and structure of care, methods of eliciting patient preferences for care, and advances in the basic science of clinical research methods focusing on ethical concerns in clinical research.

[The Institute for Global Health](#)

The Institute for Global Health, created in summer 2005, will develop and manage research and training programs in international health. Historically, developing countries have devoted their health resources toward eradication and prevention of communicable illnesses. More recently, the burden of chronic disease has grown. While the International Clinical Epidemiology Network, funded by the Rockefeller Foundation, has expanded capacity to develop regional knowledge for evidence-based clinical practice, little has been done to examine the efficiency and effectiveness of healthcare delivery. The Institute for Global Health not only will continue to develop approaches for the prevention and management of

communicable illnesses, but also will assist developing countries with mechanisms to improve the effectiveness and efficiency of healthcare delivery.

MUST-DO TASK 2

Establish a new center with research focused on the health and healthcare problems of our aging population

The Center for Quality Aging

The Center for Quality Aging will be a new center focused on the health and healthcare problems of our aging population. A focus will be on developing new methods for measuring and improving the quality and efficiency of care in nursing homes, developing and examining effective, efficient and patient-centered management strategies for the elderly with chronic illnesses, coordination of care across settings, and effective, efficient, and compassionate care at the end of life. The Center will coordinate its activities with the VA-funded Geriatric Research, Education, and Clinical Center. Center leadership has been identified and initial studies will be conducted in collaboration in our affiliated nursing home, McKendree Village.

Efforts to recruit a leadership team for this effort are well underway. Initial research efforts will include (1) Behavioral Intervention Trials, (2) Health Services Research and (3) Translational Research. The theme of the behavioral intervention trials will be to implement interventions and describe the efficacy of the interventions on clinical and quality of life outcomes. Data will be collected on staffing resources and information requirements necessary to implement these interventions in daily care practice. The theme of the health services research will be related to either workforce issues (CMS-sponsored studies to evaluate the impact of single task workers on nursing home care quality) or quality assessment and improvement efforts (a separate CMS-sponsored study to design and evaluate a new survey procedure that is more focused on care process measures as opposed to resident outcomes). These studies will nicely complement the VA-funded Geriatric Research, Education and Clinical Center which has a focus on quality and safety of care for the elderly. Translational research will follow the behavioral intervention trials. Investigators we are recruiting are currently evaluating an off-site consultation model in which nursing home personnel use software to enter quality assurance data about care process implementation. Off-site consultants (external quality assurance personnel) can then monitor these data and provide consultative support in a cost-efficient manner. The model is designed to be used by Quality Improvement Organizations sponsored by CMS and other off-site quality monitoring personnel, such as regional nurses or medical directors.

In addition to these initial research programs, Center leadership will build on existing strengths within the Medical Center to coordinate a portfolio of studies addressing disease prevention and management in the elderly, including geropharmacology, geropharmacoepidemiology, geropharmacogenomics, geropharmacoeconomics, and cognitive impairment. The Center will seek to develop McKendree Village as a “model” nursing home, particularly in the area of quality improvement. The Center will also support the geriatric medicine fellowship program and support geriatric training throughout medical school and residency training.

MUST-DO TASK 3

Establish a broader range of activity in epidemiology, including a Ph.D. program, as well as an M.S. and Ph.D. in biostatistics

Epidemiology is an important methodological science used in other areas of biomedical research, particularly research involving the use of human subjects. Establishing a doctoral program in epidemiology emerged as a must-do task during our strategic planning sessions. This program would build from the current MPH program and would be administered through the new Center for Epidemiologic Research. Doctoral candidates would complete their master's work through this program or matriculate into it having earned a MPH or MS in epidemiology elsewhere. The development of a doctoral program

will stimulate research and aid in top faculty recruitment. A further goal is to retain program graduates as Vanderbilt faculty.

In addition, the Department of Biostatistics is in the initial stages of planning for M.S. and Ph.D. programs. These programs will help VUMC meet its strategic research goals in the following areas:

- Training more M.S. biostatisticians to address the national shortage of such valuable contributors to collaborative research and data analysis
- Training Ph.D. biostatisticians in modern, flexible, experimental design and in complex modeling needed in high-density data analysis, pharmacogenomics, and other areas, and in developing and applying optimal methods for handling complex biomedical research data containing nonrandom treatment selection, missing data, nonrandom dropouts in clinical trials, and other complexities
- Continuing to attract outstanding biostatistics faculty, many of whom are interested in graduate-level teaching.
- Offering advanced courses in clinical trial design and analysis (to benefit the MSCI program and CTSA), epidemiologic biostatistics (to benefit a new Ph.D. in epidemiology program), statistical genetics (to benefit the Ph.D. in Human Genetics program), advanced experimental design (to make animal and human experimentation more ethical and efficient), biostatistical modeling and graphics (to benefit graduate students in Biomedical Informatics), and advanced biostatistical methods in biomarker, genomics, proteomics, imaging, and metabolomics discovery and validation. Biostatistical methods for personalized medicine and pharmacogenomics will also be covered in the new programs. The new degree programs will also facilitate career advancement for biomedical researchers, by tailoring some of the courses for non-biostatistics majors.

MUST-DO TASK 4

Address diversity/disparities by increasing minority research faculty hiring and expanding diversity-based research projects *via* the Vanderbilt-Meharry Alliance.

Three primary goals underpin the must-do task of expanding diversity and disparities research:

1. Increase the number of minority faculty conducting research at Vanderbilt. While this is a significant challenge for all research universities, Vanderbilt must resolve to improve at a pace that mirrors its progress in improving the diversity of its student population. Focused planning efforts involving with the Deans of Medicine and Nursing, the Office of Diversity, and the chairs of our most research-intensive departments will be required to make progress.
2. Take better advantage of the Meharry-Vanderbilt alliance to facilitate research aimed at understanding disparities in disease and treatment. In particular, the renewal of the NIH U54 (Comprehensive MMC/VICC Cancer Research Partnership) provides a structured opportunity to expand our diversity research initiatives through the Alliance. The U54 supports several joint pilot research initiatives that leverage phenotypes and tissue samples provided by the Southern Community Cohort Study to better understand the molecular epidemiology of cancer in African Americans. One or more of the most promising pilot projects will be identified for expansion and additional effort and resources beyond the scope of the U54.
3. Undertake an information-gathering and planning effort to identify a big science project that addresses diversity/disparity issues. Ideally, such a project will utilize the hypothesis-generating capabilities of the new DNA databank, then will formally test the hypothesis on a human population through the Southern Community Cohort Study. Such an effort will address, among other things, the environmental, cultural, and behavioral factors impacting disease and treatment. The project might involve diseases other than cancer, such as diabetes or heart disease. Thus, it will be necessary to expand the data-collection efforts of the Southern Community Cohort Study to include disease areas other than cancer. An example might be mining the DNA databank for information that yields genetic factors predictive of increased

mortality rates from breast cancer in African-American women. Using that information, one could perform whole-genome association studies coupled with proteomic profiling, *via* the Southern Community Cohort, to identify and confirm a panel of susceptibility markers for breast cancer that could be used to create a serum-based population-specific breast cancer screening test optimized for African-American women. In addition to this example, we will consider a range of possibilities before reaching a final decision on a project:

- Identify high-risk genotypes that uniquely predispose African American and Hispanic individuals to obesity and morbid obesity, and implement a targeted behavioral and dietary intervention in young children that is effective for prevention of obesity and its complications in adolescence and adulthood.
- Identify possible genetic markers in African-American women who deliver premature infants and link this information with environmental, cultural, and behavioral factors. There are already investigators and clinicians mobilizing around this issue and conducting some preliminary work. The genetic component and the availability to test hypotheses in the Southern Community Cohort Study could strengthen efforts. Reducing prematurity could have tremendous impact on morbidity, mortality, and healthcare delivery expenditures.
- Study relationships between genetics, socioeconomic indicators, and stress (including perceptions of institutionalized racism) in the prediction of hypertension in African Americans, and use this information to develop a targeted screen for individuals at exceptional risk for hypertension who will benefit from frequent blood pressure screening and pharmacologic intervention at an early age.

MUST-DO TASK 5

Establish focused international partnerships, with a priority of expanding our research programs in global health

Modern medicine and public health have no artificial borders. With immigration, military health issues, biodefense, emerging infectious diseases, international economic issues, and the need for vibrant overseas markets for U.S. products, health is now global, both for prevention and therapy. Many research issues cannot be addressed without an overseas component. Whether from the point of view of research competitiveness, the maximum utilization of our educational resources, or the need for global expertise for a modern America, the international/global health agenda should be an increasing part of our mission.

Nearly all dominant research universities in the United States have major efforts focused beyond U.S. borders. Johns Hopkins, Harvard, UCSF, Washington, UNC, and UCLA are all heavily invested in international health activities, while only a handful of Vanderbilt faculty are engaged in extramurally funded international work at a PI level. The comparable number at Hopkins and Harvard is easily over 60 each.

In addition, the NIH and CDC are redirecting huge blocks of resources toward international health, and we must position ourselves to take advantage of other burgeoning resource opportunities from the Gates Foundation; Ellison Foundation; NIH; Global Fund to Fight AIDS, Tuberculosis, and Malaria; PEPFAR; CDC-Global AIDS Program; USAID. Potential resources will not be fully exploited unless Vanderbilt is optimally organized. Because of this VUMC will investigate the merits of establishing a nonprofit company that could attract a broader range of resources for supporting global health research.

Vanderbilt faculty are engaged with a broad international-health family of activities. These include such diverse activities as chronic disease epidemiology studies in China, genetic studies in Africa, community health studies in Central America, and HIV vaccine studies in the Caribbean. All are expected to expand further with the support of department chairs and Medical School leadership that have sponsored their development to date. New thrusts of research are evident with the arrival of new faculty in the Institute for Global Health, begun in July 2005. These include operations and outcomes research for HIV treatment, care, and prevention activities supported through PEPFAR in Africa; HIV prevention clinical trials; and studies of women and HIV, especially in cervical cancer prevention.

Certain activities are vital for leveraging additional resources. Examples include the cardiovascular disease and cancer studies in China as a base for examination of other diseases in the same cohorts, the HIV vaccine studies in Haiti as an opportunity to extend immunopathogenesis research, and the PEPFAR service project in Africa as a base for clinical research. Hence, it will be a priority for Vanderbilt to establish a limited number of intensive overseas collaborations, including overseas on-site placement of full-time Vanderbilt faculty nested within overseas Vanderbilt administrative infrastructures, to put international- health research and medical teaching programs with plural potential into operation. The selection of partner institutions for long-term Vanderbilt working relationships will be a vital priority in strategic thinking.

MUST-DO TASK 6

Research quality assurance efforts, evidence-based medicine pathways, quality improvement dashboards

The Vanderbilt Institute Medicine & Public Health plans to expand research currently performed by the Center for Health Services Research in clinical epidemiology and outcomes, clinical improvement and operations, clinical economics, and behavioral health. Each of these areas is critical to improving the quality of care within our clinical enterprise.

As clinical faculty and VUMC partner to improve quality of care, and as the Informatics Center and the Department of Biomedical Informatics develop technology to monitor outcomes and provide decision support to improve quality of care, many opportunities for clinical and health services research will emerge. The *Clinical Epidemiology and Outcomes Research Program* will support research on defining subpopulations at varying risk for disease. Disease prevention and early-detection strategies for these subpopulations will vary, minimizing both disease incidence and cost. Investigators also will develop and examine new diagnostic and therapeutic strategies to minimize morbidity and mortality. Prognosis studies will define subgroups of patients for which disease surveillance strategies will vary and for which subsequent treatment strategies can be developed.

The *Clinical Improvement and Operations Research Program* will support research to advance methods for (a) measuring the quality of healthcare processes and outcomes; (b) identifying and designing new and better healthcare processes; and (c) implementing and spreading new and better healthcare processes. Investigators will develop and implement evidence-based pathways and the use of clinical dashboards, then examine the effects.

The *Clinical Economics Program* will support research into the cost-effectiveness of alternative strategies of care and the efficiency of healthcare processes, including both short- and long-term costs. Such studies will examine alternative deployments of healthcare manpower, the impact of information systems technology on the cost of care, and the effect of better coordination of care. Studies will include transaction-based costing strategies and macro-level examinations of overall costs to payers.

The *Behavioral Health Research Program* will support research on improving care that is patient centered. Such research will include cultural competencies in care delivery, the effects of patient literacy and numeracy, provider-patient communication, and patient healthcare behavior. It will examine the determinants of patient self-care behaviors, especially in the setting of disease prevention and chronic illness. Improving patient behaviors will have an enormous impact on the overall cost and effectiveness of healthcare.

Health Services Research investigators will collaborate with ongoing efforts in quality assurance to examine and improve institutional performance on quality metrics defined by outside review organizations. Investigators will also continue and expand their efforts in patient safety, with the goal of making our clinical delivery systems the safest in the world.

2006 Educational and Career Development Initiatives

Strategic efforts to grow the workforce in an economic sector should include a candid evaluation of socioeconomic barriers. For investigators, these barriers emerge at all career phases, even throughout the faculty ranks. Meaningful progress may demand an unbiased reconsideration of fundamental assumptions regarding training practices that encompass the entire career lifespan.

A successful model for scientific education should recognize the serious financial and training challenges that scientists face as they mature, and would prioritize sustainable economic resources to help meet these challenges. Here we will define a number of challenges in the training of M.D. and Ph.D. investigators that deserve focused attention. In some cases additional work will be needed to identify the immediate and longer-term priorities and program design. We will consider the training of M.D. and Ph.D. scientists separately, but ultimately together, recognizing that some issues are unique, while others are common to both groups.

I. M.D. Investigators

It is widely acknowledged that the number of physician scientists capable of conducting independent, peer-reviewed investigation is waning, nationally and worldwide. A major challenge in expanding the workforce of physician scientists relates to the distinctive and non-overlapping nature of clinical and investigative training. A byproduct of the dual training requirements is protracted duration, stretching into the late 30s for physician scientists in many subspecialties.

Moreover, economic disincentives arise from the combined impact of educational debt, the lengthy training period, and the lure of higher salaries in non-academic positions. The M.D. training period is not subsidized for many physician scientists, and stipends during residency and fellowship training are modest relative to similarly educated peers in other professions. It is not unusual for individuals with “ideal” physician scientist pedigrees to emerge from their final stages of training facing educational debts well in excess of \$200,000 as they consider opportunities for research-intensive careers. We will examine the challenges faced by physician scientists in two general phases of their career maturity:

1. The Pre-Faculty Phase
2. The Pre-Independent Phase

1. The Pre-Faculty Phase

This phase includes the bachelor’s/premed undergraduate period, the graduate M.D. or M.D./Ph.D. program period, and in many cases is followed by residency and clinical fellowships. At least two issues require serious attention:

a) **Duration of Training.** Our NIH-supported M.D./Ph.D. training program continues to be highly successful, with the number of students supported now at 83 (including those in clinical years), *versus* 62 only five years ago. The number of VUMC M.D./Ph.D. graduates who enter careers in academic medicine is close to 75%, which is significantly higher than the national average. The program minimizes debt by subsidizing the most costly educational period. Vanderbilt is committed to M.D./Ph.D. training for an ever-increasing fraction of its medical student class as funding from federal and philanthropic sources permit. The “Emphasis” program in the School of Medicine now provides outstanding research experiences for many of our M.D. students. For those M.D. students who become especially interested in research, the Medical Scholars Program provides a one-year, in-depth research experience normally between their third and fourth year, but sometimes after graduation or in other years. The program has attracted 32 research-oriented students since its

inception in 1998, is recognized as one of the best programs of its type in the United States, and has served as a model for similar programs across the country. At the same time, graduates of these training programs are not, at either a local or nationwide level, meeting the demand for physician scientists in the nation's research-intensive university medical centers. Recent lectures and editorials emphasize that the workforce issues force us to reconsider the duration of training for physician scientists, and ask whether the "traditional model" (Fig. 1) is either financially or socially sustainable. Completion of clinical fellowship routinely stretches into the late 30s, and the average age of first R01 funding for physician scientists is well beyond 40. An analysis of the traditional model for the education of physician scientists through the entire duration of the training, from bachelor's degree through the clinical fellowship years, is warranted. *We need to carefully consider whether a more "integrated" training model could save years of education without compromising the capabilities and contributions of these individuals as their careers mature (Fig. 1).* In tackling this issue, Vanderbilt should seek to provide national leadership. This kind of effort would require the development of novel curricula for physician scientist trainees at an early stage, as well as significant efforts to re-examine accreditation and competency in conjunction with AAMC and ACGME.

b) Research opportunities during clinical fellowships. The vast majority of physicians who choose careers in research engage in highly subspecialized clinical training at the terminal period of their educational journey (clinical fellowship). This is encouraged, as the physician scientist juggling both clinical and investigative career activities generally finds it most satisfying and productive to aim his or her combined clinical and research efforts on a highly focused subspecialty of medicine.

It is increasingly clear that the compulsory research experience during subspecialty clinical fellowships is crucial and formative for many physician scientists. At a national level, Internal Medicine and Pediatrics have led the way in developing compulsory research training components in their subspecialty clinical fellowships, although several other specialties have developed similar requirements. Until now, financial support for research training at this stage has largely been supported by NIH training grants. Unfortunately, the availability of this support mechanism is now threatened at many institutions, including our own, due to the federal budget deficit. *Hence, a dual challenge is to identify new/alternative funding sources for research training during the clinical fellowship years, and to solidify this training model in clinical specialties where a commitment to research education is not well established.*

2. The Pre-Independent Phase

In this phase, Vanderbilt has invested creatively and is making significant progress relative to its peers. Our general view has been that a highly organized "mentored bridge" is needed to support physician scientists between their residency or clinical fellowship training and the more established period where they can compete successfully for R01 funding. While physician scientists with NIH-funded basic science careers greatly outnumber those focused on patient-oriented research, our view has been that many of the challenges inherent in making junior faculty physician scientists successful in either track will be greatly improved by serious attention to two shortcomings in our existing infrastructure: 1) high quality, attentive mentoring by well-funded senior investigators, and 2) extended protected time during the early faculty years to allow faculty to focus on launching their research program.

The vast majority of physician junior faculty, even those with M.D./Ph.D. and clinical fellowship training, still have far less continuous postdoctoral research training than their Ph.D. basic scientist counterparts. Vanderbilt has recognized that because the overall duration of physician scientist training already stretches into the late 30s, traditional postdoctoral training mechanisms are economically infeasible for most individuals. Physician scientists must therefore have opportunities to acquire additional research training as faculty members. In 1999 Vanderbilt launched its Physician Scientist Development (VPSD) program, providing two years of salary support (\$75,000/year) to allow new assistant professor physician scientists to spend 75% of their time conducting research under the direct supervision of an established Vanderbilt investigator. The program requires awardees to work within the research space/program of the mentor, to ensure a close supervisory relationship, while also eliminating the need for the awardees to obtain their own supplies or equipment. As such, the experience of the VPSD awardee is designed to mimic that of a traditional research-oriented postdoctoral fellowship.

Our candidates are interviewed and selected on a competitive basis by a committee of Vanderbilt faculty that emphasizes (in equal parts) the quality of the mentor and his or her research environment, the training credentials of the applicant, and the quality of the research proposal. Physicians seeking either basic science or clinical investigation experience are supported by the VPSD (~ 1/3 of VPSD trainees are now performing patient-oriented research). Institutional experience has been that physicians seeking careers in either track suffer from similar obstacles to success (low-intensity, low-quality mentoring and inadequate protected time). Awardees focused on clinical research will usually jointly matriculate in the VPSD and didactic coursework offered through the NIH K30-supported Vanderbilt Masters Program in Clinical Investigation (MSCI). The Vanderbilt MSCI has become highly successful in its own right and is a national model for such programs. The MSCI attracts many of our young physician scientists who are in clinical subspecialties that allow them to enroll in coursework while still in their clinical fellowship training. These individuals gain a “jump-start” on their postdoctoral research training that sets the stage for a successful junior faculty experience.

A key feature of the VPSD that distinguishes it from typical K-award experiences is that participants are closely monitored (at six month intervals) by an advisory committee, a standing committee of the School of Medicine that is chaired by the Associate Dean for Physician Scientist Development, and actively seeks regular input from both the awardee and the mentor. The committee engages the awardee, mentor, and clinical department chair when problems are identified. The VPSD Program is also directed by the Associate Dean, who reports to the Dean of the School of Medicine, monitors the progress of all VPSD scholars, and directly engages departmental leadership if VPSD committee members require such support. Further, participation in the second year is contingent upon evidence of substantial scientific progress (as judged by the advisory committee), usually a pending NIH K-award application. The program is continuously evaluated and improved toward the goal of having 90% of VPSD scholars secure extramural grant funding (mentored or independent) within three years of entering the program. As of July 2005, the program has attained 85% success in this regard and the institution has experienced an increase in NIH K awards since 1999 from \$600,000 to over \$6,000,000.

A crucial outcome of all physician scientist training programs is the rate at which these scholars achieve independent funding for their research programs (R awards or the equivalent). Historically, the success rates for K awardees converting their programs to R01 funding have been disappointing, with a national rate of 22%. Although the causes of this low success rate are multifactorial, we believe the relatively unstructured supervision intrinsic to the NIH K-award mechanism is a factor. There is no structured system for supervision in most institutions receiving individual NIH K awards. Our experience through the pilot phase of the VPSD program has shown that without rigorous, systematic, and centralized monitoring, the progress of young physician scientists during the mentored phases of their career development can easily decline. This is often manifest as a gradual reduction in the intensity of the association with the mentor, due partly to distractions intrinsic to clinical obligations and sometimes due to the seduction of broader scientific “collaborations” that might occur too early in the awardee’s career. These distractions often lead to failure on the part of the award recipient to cross the difficult threshold of independent (R-level) funding. Although rigorous data to support this hypothesis are not available, Vanderbilt has experienced an increase in its K award to R01 conversion rate to 45% in FY05, twice the national average (22%). This outcome suggests that a centralized, highly structured program with dedicated resources to ensure continuous monitoring of physician scientist progress and mentoring quality can have a substantial impact on downstream success.

Hence, with a view to developing the “next generation” training model for physician scientists (Fig. 1), we will expand the VPSD model of systematic, centralized supervision of physician scientists to include not only those junior faculty in the pre-K award phase, but all K awardees at Vanderbilt.

It has been suggested that a K-award “center” model, not unlike the K12 model developed by NICHD for “Building Interdisciplinary Research Careers in Women’s Health (BIRCWH)” but expanded to include all disciplines, is the format most likely to succeed in maximizing the K- to R-award conversion rates. We will test the hypothesis that an institutional “center” tasked with managing all mentored physician scientist programs and awardees, including those scholars supported by the institution, by the NIH, and by other agencies and foundations, will significantly improve the K- to R- conversion rate. We will also evaluate

whether an “institutional center” model for all K-awardee training encourages an increasing number of physician scientists to actively seek mentoring relationships outside of their home clinical departments, and importantly, outside the traditional intellectual boundaries of their clinical disciplines.

Figure 1:

Physician Scientist Maturation		
<u>Phase</u>	<u>Traditional</u>	<u>Next Generation</u>
I.	Bachelor’s degree (4) MD, MD/PhD (4 -7 yrs) Residency (3 -6 yrs) Clinical Fellowship (3 yrs)	Integrated physician scientist training program (BS ∩ MD ∩ PhD ∩ residency ∩ clinical fellowship (10 -12 yrs)
II.	Departmental support for “startup” (2-4 yrs) NIH K Award (5 yrs)	Highly centralized and monitored institutional “Centers” that administers 5 year “K-like” career development awards (5 yrs).
Minimum Time to 1 st R01:	21 yrs	15-17 yrs

II. Ph.D. Scientists

The challenges inherent in supporting and enriching the scientific training of Ph.D. scientists are no less significant than those facing M.D. scientists, but differ in character. Nationwide, the number of U.S. citizens entering Ph.D. training in science is extraordinarily low, and recent statistics suggest that by 2010 nearly 90% of the world's scientists and engineers will be living in Asia.

Over the last decade, Vanderbilt has put tremendous energy and resources into bolstering the administrative support and overall structure housing graduate and postdoctoral bioscience education in the Medical Center. We have also recognized that as biomedical research advances, the lines between traditional scientific disciplines are becoming less distinct. Increasingly, the most accomplished researchers must possess in-depth knowledge of more than one specific field and also possess a broad understanding of principles and techniques from disciplines across the biomedical sciences.

Vanderbilt was one of the first institutions to respond to the growing need for scientists with cross-disciplinary training. Since 1992, graduate students have received a comprehensive educational foundation for a successful career in biomedical research through the Interdisciplinary Graduate Program in the Biological and Biomedical Sciences (IGP). The IGP creates an organized framework for supporting the early, largely didactic portion of graduate education in the biosciences and supports all students in identifying laboratory "rotation" experiences as they work to choose the optimal mentor and host Ph.D. training program for pursuing their thesis work.

Another recently formed graduate program that enriches the cross-disciplinary landscape is the Chemical and Physical Biology Program (CPB). This is an interdepartmental umbrella graduate program seeking students who have earned undergraduate degrees in the quantitative and/or physical sciences (e.g., chemistry, computer science, engineering, mathematics, or physics) who wish to pursue a doctoral degree at the interface of the chemical, physical, and biological sciences. The curriculum prepares students for research careers at the chemistry-biology interface, in structural biology, in molecular biophysics, or in computational biology. A unique aspect of the CPB Program is that students have the flexibility to explore their research interests from the offerings of the 12 participating departments and programs prior to choosing a laboratory for their dissertation research.

Finally, the Office of Biomedical Research Education and Training supports the Office of Postdoctoral Affairs and provides staff specifically dedicated to support and assist postdoctoral fellows during their stay at Vanderbilt. Support services are broad in scope and range from assistance with immigration and financial issues to job placement and assistance with identifying grant funding opportunities. Moreover, the "Golden Postdoc" initiative is providing additional stipend support to encourage the recruitment of exceptionally qualified postdoctoral fellows.

While these efforts have been essential in solidifying the framework of our graduate and postdoctoral programs, critical challenges remain. In order to compete nationally for the best trainees to populate our research enterprise, continued investments in space and other resources dedicated to their training experience will be required. For example, new interdisciplinary programmatic areas of focus envisioned in the research strategic plan will require complementary educational programs, which in turn will demand additional classroom space outfitted with modern computer projection and Internet capabilities, dry- and wet-lab technology workshops, and faculty re-education in these tools.

Graduate students working in VUMC departments are of high quality and have fueled the substantial growth in our research programs over the past decade. Indeed, the increase in graduate student recruitment stimulated by the establishment of the IGP program in the early 1990s was a critical factor in our success in attracting high-caliber scientists and growing the research portfolio. As we look forward to new opportunities articulated in this plan, which in many cases emphasize growth in novel hybrid disciplines and translational activities, it is essential to ensure the growth and vitality of our graduate programs. In many laboratories, graduate students will do the "heavy lifting" to bring about cross-fertilization and the development of novel approaches to scientific challenges. We need to redouble our

efforts to ensure that we are able to recruit and train the very best students and that their satisfaction with their training experience exceeds our peer institutions.

Currently, Vanderbilt is also home to 490 postdoctoral fellows, 255 with appointments in basic science departments and 235 in clinical departments. Nonetheless, there is a perception that our faculty do not compete as effectively as desired in the national talent pool of available postdoctoral trainees. Improving our visibility as a site of postdoctoral training will be critical to importing the talent that will help us accomplish the research strategic plan. Hence, we must recognize the limitations of our existing efforts and recommit to making VUMC a national leader in postdoctoral training.

“Must-do” tasks that support our goals in 1) graduate education, and 2) postdoctoral training are listed below

2006 Graduate Education

MUST-DO TASK 1

Sustain investment in graduate student recruitment to match expected growth in faculty

It is vital to grow our graduate student base in proportion to the expected growth of our faculty. While our basic science departments will continue to grow, aggressive recruitment of research-oriented chairs in clinical departments and federal goals to stimulate translational research are also fueling growth in translational research programs, with a commensurate need for graduate students supporting those disciplines. New chairs in Pathology, Neurology, Psychiatry, Biomedical Informatics, and Biostatistics have goals to grow their research programs, creating a need for additional students. To avoid diluting the numbers of trainees in departments already well-populated with graduate students, overall growth in student numbers and the resources to train them will be vital. As the exact rates of growth are uncertain and depend partly on factors related to the federal (NIH) budget, a target should be to maintain the current graduate student/faculty ratio.

MUST-DO TASK 2

Review curricular offerings of IGP in relation to the strategic plan

The IGP program continues to be a vital starting point for training our students. However, it must be regularly reevaluated to ensure access to high-quality education, adequate resources, and strategic alignment of curriculum and recruitment with faculty, program, and institutional goals. For example, the implementation of a new research strategic plan that emphasizes broader faculty use of our shared core facilities suggests a companion opportunity to train our students and fellows in the use of these developing technologies.

Internal assessments of the IGP program occur on a regular basis, but internal reviews can lack the objectivity that ensures needed course corrections. Other training programs at Vanderbilt, such as those supporting medical and MSTP student training, have benefited from external review; this as an important precedent to follow. Similarly, the IGP program would benefit from a comprehensive external review that includes input from faculty and students and provides a report to program directors and executive faculty. Implemented recommendations should sustain excellence.

MUST-DO TASK 3

Support strategies for faculty participation in graduate education

Strategic plan initiatives encourage VUMC faculty to embark on an aggressive research agenda. At the same time we must excel in training our graduate students and postdoctoral fellows. Many faculty do not feel adequately rewarded for efforts applied to graduate education, including service as Director of Graduate Studies (DGS) for a department, or time devoted to directing academic courses for Ph.D.

students. Further, when junior faculty serve as DGSs or assume substantial teaching obligations, it is critical to ensure that these efforts do not handicap career progression, given that promotion and tenure decisions are heavily influenced by research success. Recognizing high-caliber teaching contributions can decrease research productivity; therefore, it is essential that we review compensation mechanisms and promotion mechanisms across training units to ensure that graduate student teaching is rewarded sufficiently to encourage enthusiastic participation by all faculty.

MUST-DO TASK 4

Review support strategies for graduate students

Reductions in federal spending on research and training could place an increasing burden on faculty to support graduate students from their own research grants. This is reasonable and defensible when students spend their full time in support of research objectives. Graduate students make substantial and vital contributions to our research once they have completed their qualifying exams. Until then, their time is often dominated by class work and preparations for qualification, so that their contributions to research are partial at best. The School of Medicine has been able to provide support for the first didactic year of Ph.D. training from its operating funds and has been fortunate to secure a large number of training grants that can accommodate the majority of second-year trainees. However, as support for training at the federal level remains constant or is reduced and the number of available slots on training grants falls, options to support graduate students in year 2 will revert to the use of individual faculty grants (typically R01s). Some faculty will hesitate to support a second-year graduate student with R01 funding and may choose to forego mentoring students to support more senior trainees (postdoctoral fellows) or technicians who do not have conflicting time commitments. It should also be noted that opportunities to attract the best foreign graduate applicants cannot be sustained with federal training grants.

To address these issues we must review graduate student stipend and tuition support through the first two years and bolster our efforts to secure philanthropy and other sources of support for these trainees. Additionally, we should explore expanding the incentives to faculty who are willing to invest the time to develop increasingly competitive training grant applications.

2006 Postdoctoral Education

MUST-DO TASK 1

Sustain our centralized support and organizational strategies for postdoctoral programs

Toward this aim, Vanderbilt has created the Office of Postdoctoral Affairs, which is responsible for facilitating the appointment and relocation of postdoctoral fellows, developing a postdoctoral fellow handbook, coordinating visa status with the OIS and the ISSS, and maintaining the web page for postdoctoral studies at VUMC. Staff also assist fellows as they move to Nashville, facilitating enrollment in English language courses as needed and providing information on children's schools. Support includes a Career Counseling Center where staff lead "Career Day" workshops and develop resources on different career opportunities. They counsel students on how to attain career goals, assist with medical insurance, and provide database support for the preparation of training grants.

In addition, the Assistant Dean of Biomedical Research Education and Training is developing a plan to expand resources in support of postdoctoral fellows. These and other initiatives will also be available to graduate students and include:

- Developing a program where postdoctoral applicants will be recruited through advertised sites that emphasize Vanderbilt's strengths in proteomics; imaging; bioinformatics; biomedical research; mathematical modeling; translational research; chemical biology; human genetics; and genetic modeling using *C. elegans*, zebrafish, *Drosophila*, yeast genetics, and murine models.

Recruitment criteria will be developed and fellows will be placed in key laboratories using training grants and individual fellowship awards.

- Facilitating submission of research fellowship applications for postdocs. Up-to-date listings of fellowship deadlines will be sent to fellows by e-mail. Guidance will be offered to facilitate timely application submission and to increase application success rates.
- Reviewing access to daycare for postdoctoral trainees with families. Access to daycare is a vital resource for VUMC faculty, postdoctoral fellows, students, and staff alike. This issue extends beyond VUMC into all areas of the University and is under review by senior management.
- Developing and implementing standardized criteria for the duration of postdoctoral training. We will also facilitate career advancement by working to improve mentoring and placement, grant writing, and support in obtaining independent funding. Resources will include development of a communication center where fellows can get help with manuscripts and grant writing and refine their oral presentations.

MUST-DO TASK 2

Review support strategies for postdoctoral trainees, including incentives for postdoctoral fellowship awards

In order to attract the most highly qualified trainees and to enhance the visibility of postdoctoral training at Vanderbilt, a “fellowship” program that might fund 5–10 candidates per year at an enhanced salary (for example, \$50,000 per fellow) could be developed and nationally advertised. Named fellowships, ideally supported by philanthropy, would add prestige to these recruitment opportunities and could recognize successful former Vanderbilt postdoctoral trainees who have achieved nationally visible laboratories and/or industry/government appointments. Training areas of emphasis for support by this mechanism could be linked to the priority growth areas in the research strategic plan and we would consider only the most outstanding candidates.

Additionally, a broader program could include a modest financial supplement to augment the salary of a larger number of meritorious applicants, extending up to 20 or more postdoctoral trainees per year. For either program, faculty would be expected to provide at least NIH-level support for the postdoctoral salary. Candidates for either program could be reviewed and selected by a faculty committee, with the consultative advice of the Dean and the Office of Research.

Visible efforts to enhance the professional development of postdoctoral fellows already recruited to VUMC will pay dividends in improved ability to recruit future candidates and retain the most talented fellows as faculty. One opportunity would be an institutional grant mechanism, akin to our former “Bridges to Independence” program, that would offer senior fellows the opportunity to acquire funds for pilot experiments. Given other financial priorities, the number of these awards might be small (two per year), targeted to the best trainees, linked to the strategic plan, and not overlapping with existing funding. This idea is consistent with recent recommendations of the National Academy of Sciences to address training dilemmas for postdoctoral fellows; implementing it now could allow us a competitive advantage over peer institutions. Another opportunity is to offer a small, one-time reward (\$1000) to postdoctoral fellows successful in obtaining NIH or other postdoctoral fellowship awards to support their salaries. These efforts would provide clear recognition for a job well done, raise morale, and encourage more fellows to solicit external support. If initiated, these mechanisms should be advertised nationally as a statement of the support postdoctoral fellows receive if they choose to train at Vanderbilt.

III. Maturing M.D. and Ph.D. Investigators

While the challenges surrounding the establishment of an independent laboratory and obtaining initial R01 funding are the stuff of legend in academic medicine, an entirely unique set of circumstances may limit the continued success of maturing investigators with either M.D. or Ph.D. training backgrounds. In many respects, the key challenges are similar to learning to manage a growing program that resembles a small business. Maturing faculty must become accustomed to managing the success or failure of others

(*versus* only oneself) and must learn to delegate responsibility in order to scale the productivity of their laboratory to ensure their funding will be renewed 3–5 years later. These skills are often not natural for scientists rigorously trained to manage all details themselves. Moreover, a robust research program at most institutions requires at least two sources of funding (two R01s or the equivalent). The maturing investigator must therefore initiate new science on a much faster time scale than ever before (without the luxury of the 3–5 year K award or “start-up” period).

The financial and mentoring resources needed to help these investigators invest in pilot studies for new, sometimes risky programs of science that will lead to a second source of funding are highly variable across our departments and centers. While few institutions have instituted focused programs targeted at this phase, it would be worthwhile to consider a solution that is more structured than present practice. At VUMC, we will evaluate the merits of a more formal support mechanism, termed here as “Established Investigator Awards.” These awards could be designed to assist faculty who have achieved R01 funding and seek to move to the next stage in their career by obtaining multiple, diverse funding sources. These awards would provide additional support for pilot projects and would also incorporate formal didactic training sessions involving an introduction to the finance and personnel management issues specific to academic medicine and laboratory research.

IV. Career Development of Non–Tenure Track Research Faculty

Our practices for appointment, promotion, mentoring, and funding for research track faculty positions vary throughout the institution. Research-track faculty provide key scientific collaborative interactions with individual faculty and with groups of faculty, play key roles as leaders or collaborators on federal and industry grants, and provide leadership in our shared core facilities and major interdisciplinary initiatives. Research-track faculty are therefore crucial to Vanderbilt’s vision for playing a leadership role in U.S. biomedical science. We must retain them, facilitate their professional growth, establish guidelines for their advancement, and enhance their job satisfaction. The following recommendations are aimed at achieving these goals:

- 1.** Establish more explicit School of Medicine guidelines for non-tenure research track faculty appointments and promotions. These guidelines would articulate one or more “approved” career development models for research track faculty, as outlined below. The department chair would outline a career development plan, embracing one of the approved career development models, and would clearly articulate this plan in a letter to the Dean as part of the request for a faculty appointment.
- 2.** Develop a career development model for non–tenure track research faculty who will be expected to achieve extramural funding through their work with a PI. Training would be provided to facilitate this goal, including grant writing, manuscript writing, lecture skills, and management techniques. After achieving successive levels of success (e.g., obtaining grants, publication of cutting-edge papers, national and international recognition at conferences), promotion to research associate professor or research professor would be possible. These faculty members would be expected to work with the PI to develop a mentoring team to guide their career development and support their scientific and professional growth.
- 3.** Develop a career development model to support non–tenure track research faculty playing key roles in the success of our shared core facilities and our transdisciplinary research initiatives. For these individuals, fostering “interdependence” is the key goal. These faculty would continue to develop the latest technical skills and training, lead research into new avenues, and stimulate transinstitutional collaborations and interdepartmental collaborations. This track would be appropriate for Ph.D. scientists working in our shared core facilities or major transdisciplinary programs, where it would be expected that the faculty would take a major role in facilitating the development of grant support for the core facility or faculty who utilize the facility. As such, these faculty members could be promoted and recognized for facilitating success with

manuscripts and grants, and would often be identified as a coinvestigator or collaborator on awarded grants.

4. Develop a new “research scientist track,” a non-faculty staff position for Ph.D. scientists working in laboratories who do not plan to take an active role in identifying extramural support for their salary and research activities or in helping lead and organize the activities of shared cores or major interdisciplinary programs. Individuals with this profile play crucial roles in the laboratories of many VUMC PIs. A career ladder with milestones for promotion is needed for scientists working in this track, which might recognize their active role in completing projects that lead to publication of manuscripts or successful funding of grants.
5. At times, changes in grant support require that faculty or staff in one of these tracks receive notification that their contract will end. In such cases, the institution should develop an approach to ensure that career counseling is identified for these individuals at the time they receive such notification. Such counseling should continue through their transition to a new position, either within or outside VUMC.

Priorities and the Future

As a result of the detailed addition of Basic Sciences to the Strategic Plan, priorities which can be classed as higher and highest can be identified. In this section a brief overview of one such classification is presented.

Highest Priorities

Assistant Vice Chancellor for Research, Basic Sciences – Basic science-oriented faculty voiced the need for an individual who could collect input pertaining to the basic science mission from stakeholders and enhance liaison of the faculty with upper levels of the administration. One mechanism to address this would be to create a new Assistant Vice Chancellor position, to quickly identify him/her and allow such work to begin as soon as possible.

Database – Developing an in-house searchable database containing VU specific research information is very important to our investigators. Perhaps this could be spearheaded out of the Assistant Vice Chancellor for Research's office, but it will require extensive effort (at least 50% time) by an experienced investigator as leader.

Measurement of Progress – The administration, with advice from the faculty, must establish new methods for evaluating progress. Dollars are convenient, but do not at all measure the progress of individuals, departments and the institution.

Basic Support of Faculty – This effort should move in at least two directions. First, the cost of cores should be very carefully examined. It seems likely that costs should be reduced by increasing Vanderbilt support. At the same time, support for innovative research should be made available to faculty to allow doing those experiments that will expand the work of a laboratory beyond that currently funded by granting agencies.

Awards Committee – This committee should identify faculty who can be nominated for all awards in different disciplines. While most highly visible awards are NAS, HHMI and IOM, we should focus also on the many awards presented each year by scientific societies and foundations thereby increasing the visibility of individual faculty and our research environment.

Higher Priorities

Graduate/Postdoctoral Education – The Must-do tasks identified by this committee which, when joined together, will greatly enhance our research environment. First, centralized funding for graduate training should be established. Progress has been made in this direction and should now be completed. Second, evaluation of graduate programs by both internal and external committees is necessary. In fact, this should be done for all units including departments, institutes and even cores. Third, establish a plan, including resources, to bring both graduate students and postdoctoral fellows from other countries to our campus, thereby expanding both our research capabilities and visibility.

Communication – This topic was addressed by more than one committee and they are grouped together as one of the high priorities. Using faculty advice, enhanced web-based and email communication, consolidation of "so-called" required forms to be filled out by faculty should be done. It goes without saying that conflict of interest and time and effort recording must be carried out. However, it is not obvious that other requirements for faculty are necessary and a consolidation or elimination of requirements should be established.

All of the remaining must-do tasks are of high priority and should be addressed as soon as possible. It should be clear to all that each task suggested by each committee has been carefully crafted by both the

committees and by advice from faculty outside the committee. Each has its own intrinsic value. Those highlighted above could be considered the most important in rapidly improving our research environment. As the committees worked through this process, one unifying fact became clear. The most rapid path to success is for departments and institutes to set aside their personal interests for the good of our general research programs. One of the most important shifts in our current culture is to add to our faculty one or two of the very finest scientists available over the next 10 years, regardless of their discipline. This is an important way to achieve the goal of more NAS and HHMI members. Because a significant amount of resources will be necessary, each department cannot expect to have its turn in having someone in their discipline recruited. We must find the very best person we can attract, regardless of scientific area.

Several of the must-do tasks will require little or no investment of resources to accomplish their goals. Others could be rather expensive. It will be a mistake if we do not address our needs in a very aggressive way. For example, recruitment of the very best scientists mentioned above should not rely on resources available in departments or institutes/centers who will expect quid-pro-quo. Rather resources should be found elsewhere. It is important to remember that our current success is based largely on two events, contribution of about \$75 million to research on our campus by the Board of Trust followed shortly by a masterful first strategic plan. We are now taking the next step and this current strategic plan is an essential guide for this. But also the university needs to consider contributing financially to our effort.

The idea of “freshening” this strategic plan on a regular basis is very important. The themes of this strategic plan are underway and there already is a beginning of the tasks described for basic science research. All of these topics need to be reexamined on a regular basis to remove those that have been finished and to add new ideas which will appear rapidly as research, translational or basic, continues to develop at a dizzying pace.

Financial Measure of Success

The VUMC research enterprise strategic plan positions us to become one of the few research-based academic medical centers (AMCs) in the country with the broad infrastructure and specialized talent required to tackle the most difficult and compelling challenges in human health. This plan outlines a focused growth trajectory that will create the infrastructure and resources needed to allow faculty to engage in science at all levels, from the bench to the bedside to where the healthcare process is studied and reformed system-wide. At the same time, this plan will propel high-impact “big science” initiatives that will produce discrete breakthroughs—from new drugs to screening technologies to IT-based data management solutions—with direct impact on the prevention and treatment of disease. It should be recognized that the research enterprise will continue to aggressively assess new opportunities as they emerge, and will modify “The Plan” when new directions are sufficiently compelling to prioritize over existing activities.

While addition of space has been a fundamental to this growth, a key element of our success has been our ability to optimize research space productivity. Through strategic allocation of resources by departments, centers, and the Schools of Medicine and Nursing, careful planning of our building projects, and our unique infrastructure for core resource use and management, we have increased the financial productivity of our research space in terms of direct revenue from all sponsors to \$370/ sq ft (Figure 4). This approaches the top of the range of AAMC-reported research space productivity (\$400/sq ft).

This success speaks to outstanding faculty efforts to obtain funding in an increasingly competitive environment, to work collaboratively, and to maximize core facilities. Maintaining this level of financial productivity is essential to cover the rising costs of supporting research space (mortgage interest, energy costs, maintenance, etc.). *Hence, continued efforts to maintain high financial productivity in both new and existing research space will be essential if we are to secure the cash-flow needed for discretionary spending, including investments in new faculty and the expanded infrastructure outlined in this strategic plan.*

Wherever possible, development funds for departments and centers will be prioritized toward faculty programs outlined as “must-do” items in this plan, as in most cases these items are well aligned with existing department and center strategic goals. “Must-do” items that are not faculty programs but that are designed to bolster research infrastructure (animal care, shared cores) will largely be supported through our annual increment in indirect dollar revenue from sponsored awards as well as through ongoing operating fund allocations from the School of Medicine to centers and departments as budgetary flexibility permits.

Finally, we should recognize that the NIH cannot be the only source of support for our big science initiatives. Hence, a major part of the project management responsibility attached to each of these initiatives will be to work closely with Medical Center Development to garner focused philanthropy in support of the initiative, with accompanying support from nonprofit organizations. The Medical Center will greatly expand its philanthropy support (development offices) manpower over the next two years, with the goal of expanding our endowments supporting research and clinical and educational programs. There may also be potential for future support for these initiatives from Academic Venture Capital funds.

As noted previously, our success in obtaining increased funding cannot be the only measure of our progress. While the figures below indicate our impressive growth in funding, we must also use other criteria (such as publication in the highest quality journals, invitations, major editorial roles) to measure progress of our faculty as individuals, departments/centers/ institutes, and the institution as a whole.

Figure 1

2000-2004 Compound Average Annual Growth Rate - NIH Funding

<u>Rank</u>	<u>Institution</u>	<u>Compound average annual growth(%)</u>
1	Vanderbilt University	20.4
2	Duke	15.2
3	UCSF	14.4
4	U Washington	14.0
5	UCSD	12.7
6	Emory	12.7
7	U Pittsburgh	12.3
8	UCLA	11.9
9	UNC	10.2
10	UAB	10.2
	Top 25 average	10.3

Figure 2

% Growth - NIH, AMC #10 in NIH rankings, VUMC

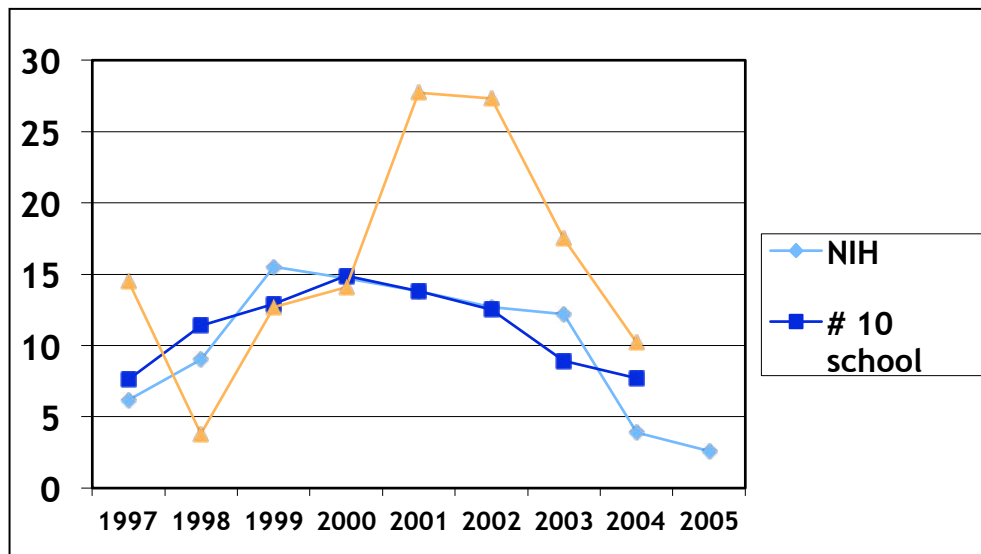


Figure 3

**VUMC Research
NIH Funding – National Rankings 2004**

1. Johns Hopkins	\$449,470,782	10. Stanford	\$265,499,858
2. U of Penn	\$393,623,671	11. Baylor	\$248,451,313
3. UCSF	\$379,851,608	12. U Michigan	\$245,342,433
4. Wash U	\$371,719,472	13. Case Western	\$232,074,070
5. U Wash	\$307,873,069	14. UCSD	\$231,023,209
6. Duke	\$304,740,667	15. Vanderbilt	\$226,826,142
7. Yale	\$287,811,325	16. Columbia	\$226,575,848
8. UCLA	\$285,852,720	17. UNC	\$212,868,565
9. U of Pittsburgh	\$270,642,802	18. UAB	\$207,078,637

Figure 4

VUMC Research Space Productivity

	<u>FY1999</u>	<u>FY2001</u>	<u>FY2004</u>	<u>Projected</u> <u>FY2007</u>	
Tot. Rsch Awards (x 1000):	\$153,000	\$200,000	\$293,000	\$375,942	\$429,648
				8%/yr	14%/yr
Direct revenue: (excludes IDC, x 1000)	\$93,000	\$113,000	\$185,400	\$237,370	\$271,280
VUMC Rsch Space (sq ft):	315,000	307,000	502,202	678,202	678,202
Productivity (Direct \$/sq ft):	295	368	370	350	400
		↑	↑		↑
		Preston MRBIII	Imaging Inst MRB IV		Dry Lab new vivarium

Range in reported AAMC space productivity (direct \$/sq ft): 198-400

Figure 5

Average Annual \$ Change FY99-04

<u>Rank</u>	<u>Institution</u>	<u>\$ (millions)</u>
1	Johns Hopkins	39
2	UCSF	32
3	U Pennsylvania	31
4	Duke	30
5	Washington U	29
6	UCLA	29
7	U Washington	28
8	Vanderbilt	26
9	U Pittsburgh	23
10	UCSD	21

Figure 6

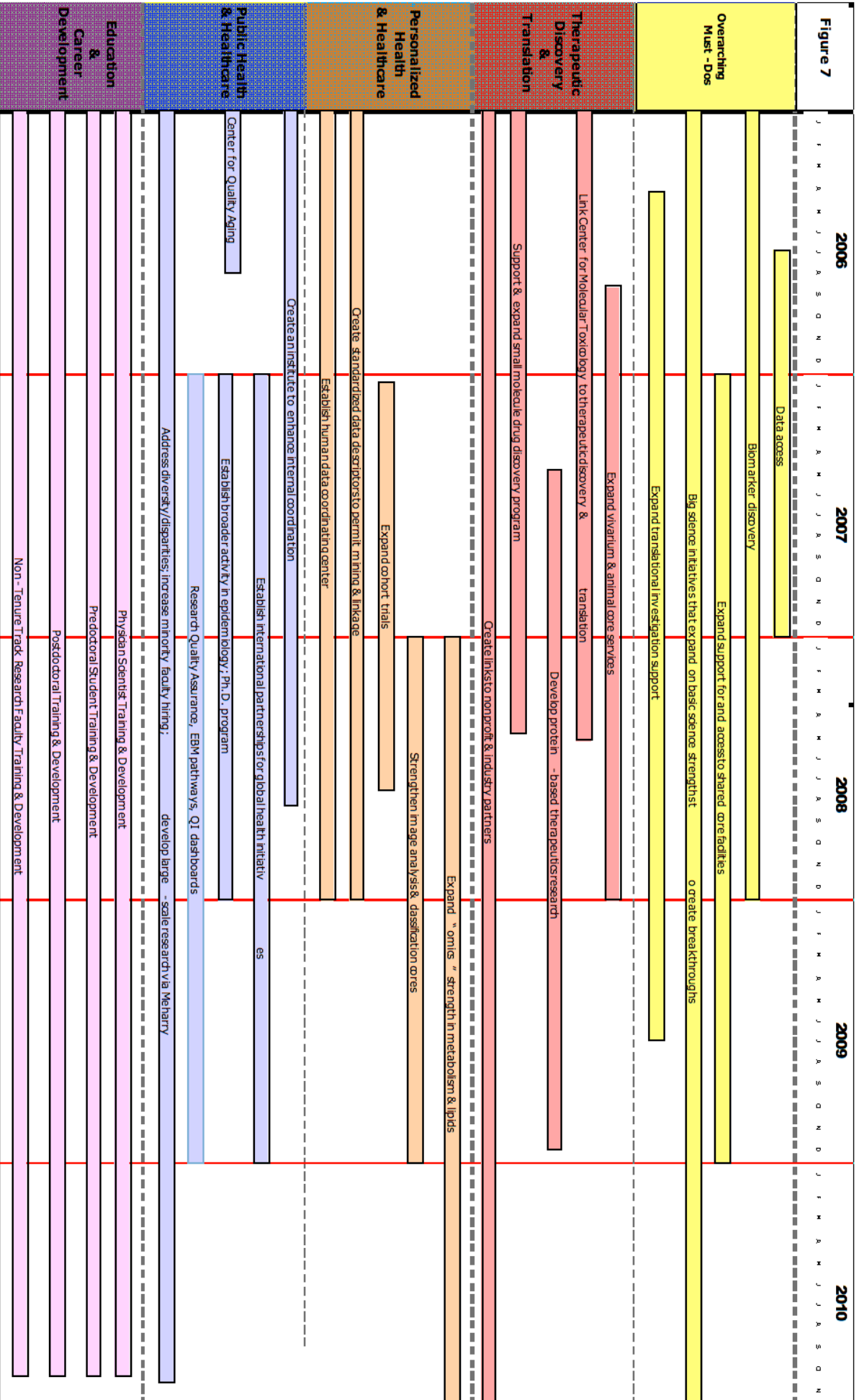
Total Awards and Research Development Expenses

1990-1994: \$3.9m/yr (avg)

1995-1999: \$8.8m/yr (avg)

<u>FY</u>	<u>Awards</u> (\$ millions)	<u>% Inc</u>	<u>PI's</u> (funded)	<u>% Inc</u>	<u>Dev. expense</u> (\$ millions)	<u>% Inc</u>
99	120,065,014		358		12,628,923	
00	143,045,178	19.1	369	3.1	12,069,660	-4.4
01	156,389,494	9.3	392	6.2	14,358,636	19.0
02	211,980,117	35.5	439	12.0	17,995,489	25.3
03	256,456,447	21.0	466	6.2	21,720,481	20.7
04	292,496,724	14.0	520	11.6	24,222,729	11.5
05	322,561,460	10.3	560	7.7	24,000,000	-0.9
Avg change/yr:	33,733,333	18.2	33.6	7.8	1,895,333	11.8

Figure 7



Appendix I — Vanderbilt Centers Working in Public Health

The Vanderbilt Center for Better Health accelerates improvements in healthcare systems through expanded use of informatics in healthcare delivery. It facilitates strategic planning for healthcare organizations and is coordinating projects on the expanded role of clinical information systems to improve health and healthcare.

The Center for Evidence-Based Medicine facilitates the incorporation of new understandings of improving the effectiveness and efficiency of healthcare delivery into the delivery systems at VUMC. It also facilitates the spread of successful advances in healthcare to outside organizations.

Center for Health Services Research operates six research programs: 1) The Clinical Epidemiology and Outcomes, 2) The Chronic Disease and Molecular Epidemiology, 3) The Clinical Economics and Decision Sciences, 4) The Health Behavior and Education, 5) The Clinical Improvement and Operations, and 6) the Health Policy Program. It includes the Perioperative Outcomes Research Program, Multicenter Orthopedic Outcomes Network, the Pediatrics Health Services Research Program, the Center for Improving Patient Safety, the Center for Education and Research in Therapeutics, the Vanderbilt Health Promotion and Disease Management Center, the VA Center for Patient Healthcare Behavior, the VA Geriatric Research, Education and Clinical Center, the VA Clinical Research Center of Excellence, and the VA Quality Scholars Program.

The Center for Medicine, Health and Society links the humanities and social sciences with the health professions. It has more than 100 affiliates from all nine schools and colleges of the University. It offers an undergraduate program (minor and contract major in Medicine, Health, and Society) and sponsors seminars, workshops, lectures, and conferences. Projects of direct relevance to the Institute include patient and provider behavior, defining and measuring patient-centered outcomes, examining ways to improve the processes and structures, and evaluating the impact of new patient-centered approaches to care.

The Joint Center for Nursing Research serves as the central resource, repository and facilitator of faculty, student, and nursing staff scholarship. It facilitates scholarly activity and promotes new knowledge and improved care delivery to the community and the nation. It achieves this mission through established relationships between the school of Nursing, the University and hospitals and affiliated healthcare agencies.

The Institute for Community Health conducts health services and public health research and training focused on eliminating health disparities. It has four cores: administration, research, shared resources, education and training, and community outreach. It coordinates activities with the new Center for Optimal Health at Meharry and provides faculty support, trainee stipends, and tuition support.

The Center for Clinical and Research Ethics offers multidisciplinary academic and clinical programs whose purpose is to address the moral and ethical issues presented within clinical and research contexts.

The Center for Genetics and Health Policy offers multidisciplinary academic and clinical programs addressing the impact of genetics on healthcare and health policy.

The Institute for Global Health develops and manages research and training programs in international health. It develops approaches for the prevention and management of communicable illnesses and will assist developing countries with ways to improve the effectiveness and efficiency of healthcare delivery.

The Department of Biostatistics develops and applies methods for estimating treatment efficacy, the yield of diagnostic technologies, impacts of risk factors for diseases and for adverse prognosis, clinical safety of pharmaceuticals, for minimizing the number of subjects needing to be studied, and for various analyses applied to Health Services Research. Faculty and staff in Biostatistics collaborate with faculty in many departments and centers to optimize the quality and reproducibility of biomedical research.

Appendix II — Core Resources at VUMC

(updated 11/11/11)

Advanced Computing Center for Research & Education (ACCRES)

<http://www.accre.vanderbilt.edu/>

Offers computing resources flexible enough to enable High Performance Computing applications in a wide variety of research and education areas. Researchers from thirty campus departments and four schools use ACCRES for their computation needs.

Contact:

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Antibody and Protein Resource

<http://www.vanderbilt.edu/vapr>

Provides services for generation, purification and characterization of monoclonal antibodies, polyclonal antibodies, and recombinant proteins. The core provides many related technologies including protein:protein affinity measurement, protein:small molecule affinity measurement, CHO cell expression optimization, cell line sub cloning, and recombinant antibody generation and expression.

Contact:

Rob Carnahan, Director

robert.carnahan@Vanderbilt.Edu

Biomolecular NMR Facility

<http://structbio.vanderbilt.edu/nmr/>

The facility currently operates four Bruker spectrometers: One Avance AV-III 500, two Avance AV-III 600, one Avance AV-III 800 and one Avance AV-III 900. Each of these spectrometers is fully equipped with hardware for all modern multi-nuclear experiments including cryoprobes, gradients and the capability for multi-channel pulsing with deuterium decoupling. Training, including basic, advanced and special topics, is offered by facility experts.

Contact:

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Biomolecular Crystallography Facility

<http://structbio.vanderbilt.edu/xray/>

The facility exists to make structural analysis by crystallography available to researchers on the Vanderbilt campus by providing state-of-the-art equipment and instrumentation, training, software, and support for all aspects of crystal structure solution. The facility is also available to train and support researchers wanting to learn crystallography as a valuable research tool. Vanderbilt crystallographers have excellent access to macromolecular beamlines at SER-CAT and LS-CAT, which are routinely available to Vanderbilt researchers for on-site and remote data collection and for mail-in data collection.

Contact:

Joel Harp, Director

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Biophysical Instrumentation Core Facility

<http://structbio.vanderbilt.edu/wetlab/instrumentation.php>

The core maintains a variety of instruments for studying the conformation and stability of macromolecules and for measuring the affinity and thermodynamics of biomolecular interactions. These include the Jasco J810 Circular Dichroism Spectropolarimeter, MicroCal VP-Differential Scanning Calorimeter, Horiba Jobin Yvon Fluoromax Fluorometer, and MicroCal VP-Isothermal Titration Calorimeter.

Contact:

Laura Mizoue, Director

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Biostatistical Shared Resources:

Biostatistics Collaboration Center (BCC)

<http://biostat.mc.vanderbilt.edu/wiki/Main/BCC>

Provides, enhances, and/or facilitates statistical collaborations involving the design, conduct, analysis or publication of biomedical research at the university. The BCC is comprised of biostatisticians and computer systems analysts offering a wide range of highly trained experts with unique expertise for almost any collaboration.

Contact:

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Center for Quantitative Sciences

<http://www.vicc.org/biostatistics/about.php>

Provides consultative services for Vanderbilt-Ingram Cancer Center investigators in the statistical design, conduct, and analysis of studies; collaborates in funded research efforts initiated by VICC laboratory and clinical investigators, by providing statistical expertise in study design, power and sample size analysis; data analysis; interpretation of results; and writing of manuscripts; provides relational database design, data tracking, forms, queries, and reports for investigator-initiated clinical trial databases or laboratory study databases; and develops and evaluate statistical methods for experimental design and data analysis.

Contact:

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BioVU – Vanderbilt DNA Databank

<https://starbrite.vanderbilt.edu/biovu/> (requires VUnet ID and ePassword)

Provides enabling resource for exploration of the relationships among genetic variation, disease susceptibility, and variable drug responses, and represents a key first step in moving the emerging sciences of genomics and pharmacogenomics from research tools to clinical practice. A major goal of the resource is to generate datasets that incorporate de-identified information derived from medical records and genotype information to identify factors that affect disease susceptibility, disease progression, and/or drug response.

Contact:

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Cell Imaging Shared Resource(CISR)

<http://www.mc.vanderbilt.edu/cellimage/>

CISR currently provides facilities for both optical and electron microscopy; there are six confocal microscopes, one line-scanning microscope, two 2-photon-excitation microscopes, and four advanced wide-field microscopes as well as a Phillips CM-12 120keV Transmission Electron microscope system. The laboratory is fully equipped to carry out numerous aspects of "routine" as well as specialized electron microscopy, including preparative, research, and analytical techniques.

Contact:

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&

Jay Jerome, co-Director, EM core

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Center for Human Imaging

<http://www.vuiis.vanderbilt.edu/resources.php>

Provides structural and functional MR Imaging and Spectroscopy at 3 and 7 Tesla, MRI/MRS protocol development support, fMRI experimental design support, Quantitative imaging of cancer, subject preparation and pre/post testing facilities, structural and functional image analysis, and training on image analysis techniques and tools.

Contact:

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Center for Small Animal Imaging

<http://www.vuiis.vanderbilt.edu/resources.php>

Provides in vivo and ex vivo imaging capabilities of small animals and tissue samples via magnetic resonance imaging, x-ray/X-ray CT, Positron emission (PET) and single photon emission and bioluminescence/fluorescence imaging. The center also provides training for users on ultrasound and optical imaging; expert instrument operators for other modalities; and support/training for data/image analysis.

Contact:

Mark Does, Director

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Center for Molecular Probes – Radiochemistry

<http://www.vuiis.vanderbilt.edu/resources.php>

In conjunction with the VUIIS synthetic chemistry laboratories, the Radiochemistry shared resource is comprised of four distinct laboratories set up for the exclusive purpose of radiochemical and radiopharmaceutical preparations.

Contact:

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Chemical Synthesis Core

<http://www.vanderbilt.edu/syncore/>

The primary focus of the core is to facilitate biology-orientated projects within the medical center and the university by assisting with the chemistry aspect of the project. The core works independently or in collaboration with the VICB High Throughput Screening Center on the synthesis of literature-cited compounds (including patented ones) as well as full scale lead optimization of a compound.

Contact:

Padma Portonovo, Manager

padma.s.portonovo@Vanderbilt.Edu

Computational Genomics Core

<http://chgr.mc.vanderbilt.edu/page/computational-genomics-core>

Provides the hardware and software support, along with expertise for programming, database development, systems administration and bioinformatics as they relate to any aspect of genetics. The core harbors all the necessary programs for genetic statistical analysis, including both linkage and association analysis, and also hosts the Celera Genomics Databases.

Contact:

Jonathan Haines, Director

jonathan@chgr.mc.vanderbilt.edu

Division of Animal Care

<https://www4.vanderbilt.edu/acup/> (requires VUnet ID and ePassword)

Provides procurement, husbandry, and healthcare for experimental animals, as well as scientific/technical support for VU researchers.

Contact:

Jeanne Wallace, Director

jeanne.wallace@vanderbilt.edu

DNA Resources Core

<http://chgr.mc.vanderbilt.edu/page/dna-resources-core>

Provides services in DNA extraction, DNA sample banking, genotyping, and other services that support molecular genetics studies. Once DNA has been extracted, it can be returned immediately to the investigator or banked for future use. The core offers custom genotyping services with our ABI 7900 platform for TaqMan Allelic Discrimination assays, the Sequenom MASSArray, the Illumina BeadXpress, or the ABI OpenArray.

Contact:

Holli Dilks, Director

Cara Sutcliffe, Manager

cara@chgr.mc.vanderbilt.edu

Flow Cytometry Core

<http://www.mc.vanderbilt.edu/root/vumc.php?site=flowcytometry>

Provides flow cytometry services to faculty, staff, and students in the VUMC and to other investigators on a fee-for-service basis. The staff maintains all instruments and provides the following services: Data acquisition, both by facility staff and qualified users, sorting, instruction in performing data analysis, instruction on instrument use (analytical machine), consultation on experimental design, sample handling, and staining protocols, education on basic principles of flow cytometry through seminars, lab meetings, and course work.

Contact:

Kevin Weller, Managing Director

kevin.p.weller@Vanderbilt.Edu

Genetics Studies Ascertainment Core

<http://chgr.mc.vanderbilt.edu/page/genetics-studies-ascertainment-core>

Responsible for identifying, ascertaining and collecting samples from patients and families participating in genetics studies. The core provides appropriate counseling, blood and buccal smear collection, and obtains clinical data and biological samples from distant participants.

Contact:

Holli Dilks, Director

Renee A. Laux, Manager

renee.laux@vanderbilt.edu

Genome Sciences Resource (GSR)

<http://gsr.vanderbilt.edu>

The GSR provides state of the art genomics services to Vanderbilt investigators, integrating tools for interrogating the genome with analysis and bioinformatics to characterize gene expression and variation. In addition to multiple liquid handling, array processing and capillary sequencing platforms, the core has two Illumina HiSeq2000 instruments to support NGS workflows. A unique feature of the GSR is the availability and customizability of several major genomics technology platforms, which offers exceptional flexibility in analytical approaches.

Contact:

Chris Coldren, Director

chris.coldren@vanderbilt.edu

gsr@vanderbilt.edu

High - Throughput Screening Facility

<http://www.vanderbilt.edu/hts/index.htm>

Provides services for consultation in assay design and development, assay validation, high-throughput screening (HTS) and automated data analysis. Its compound collection can be accessed independently of screening, and the facility offers HTS compatible supplies for testing and validation. Training services are also provided to allow for walkup use of state-of-the art instrumentation.

Contact:

Lisa Wright, Manager

lisa.m.wright@vanderbilt.edu

Hormone Assay & Analytical Services Core

<http://hormone.mc.vanderbilt.edu/>

Assists investigators in the measurement of amino acid profiles and hormones in biologic fluids as related to diabetes and endocrine and metabolic research. The core provides space, equipment, and personnel for sample analysis and method development.

Contact:

Wanda Snead, Manager

wanda.snead@vanderbilt.edu

Human Immunology Core

<https://www.mc.vanderbilt.edu/root/vumc.php?site=immunocore>

Provides a wide-range of support and assays to assist investigators in their research with a primary interest in assessing cellular immune responses during clinical trials. The Core assists investigators with sample processing, storage, shipping, documentation, assay design, assay development and evaluation of immune responses.

Contact:

Mike Rock, Managing Director

michael.rock@vanderbilt.edu

Mass Spectrometry Core Laboratory

http://www.mc.vanderbilt.edu/root/vumc.php?site=msrc/mass_spectrometry_core_lab

Provides instrumentation for structural analysis of biological molecules and qualitative and quantitative assays of chemotherapeutic agents and metabolites in physiological fluids. The instrumentation facilities consist of a variety of mass spectrometric and high-pressure liquid chromatographic systems.

Contact:

David Hachey, Director

david.l.hachey@vanderbilt.edu

Mouse Metabolic Phenotyping Center

<http://www.mc.vanderbilt.edu/root/vumc.php?site=mmpc>

Provides novel experimental tools to the scientific community for phenotyping mouse transgenic models of diabetes and related disorders.

Contact:

David Wasserman, Director

david.wasserman@Vanderbilt.Edu

Murine Neurobehavioral Laboratory

<http://www.vandymouse.org/>

Offers fundamental behavioral testing services for the assessment of a variety of physiological and psychological processes, and provides training and consulting for investigators in the analysis of behavioral phenotypes in mice.

Contact:

John Allison, Manager

john.allison@vanderbilt.edu

Neurochemistry Core Laboratory

<http://www.vandyneurocores.org/>

Offers services for neurochemical profiling of brain, peripheral tissues and body fluids. The core provides analytical services for the quantitation of multiple biogenic amine neurotransmitters (e.g. dopamine, norepinephrine, serotonin, acetylcholine), biogenic amine metabolites, amino acids and amino acid neurotransmitters (e.g. glutamate, GABA).

Contact:

Ray Johnson, Manager

ray.johnson@Vanderbilt.Edu

Proteomics Core

http://www.mc.vanderbilt.edu/root/vumc.php?site=msrc/proteomics_core

Provides state-of-the-art instrumentation and expertise in analytical proteomics, proteome profiling, and imaging to Vanderbilt researchers. Instrumentation is available for protein and peptide separations by 2D-gel electrophoresis and multidimensional high performance liquid chromatography (LC). Proteome profiling and imaging in frozen tissue sections are done by matrix-assisted laser desorption ionization-time of flight (MALDI-TOF) MS. Proteomics Laboratory staff provide consultation on experimental design and sample preparation.

Contact:

David Hachey and Kevin Schey, co-Directors

k.schey@Vanderbilt.Edu

Rat Neurobehavioral Laboratory

https://medschool.mc.vanderbilt.edu/rat_core/?q=node/2

Provides equipment, training and consulting for Vanderbilt personnel who are interested in studying rat models of both neurological and psychiatric disorders. Examples of assays available for research in rats include models of anxiety, depression, drug abuse, learning and memory, cognition, attention, social interaction, pain, motor activity and coordination. Investigators can employ the latest technology in video capture and software-based analysis of behavior.

Contact:

Randy Barrett, Manager

randy.barrett@Vanderbilt.Edu

Survey & Biospecimen Shared Resource

<http://medicineandpublichealth.vanderbilt.edu/center.php?userid=1579214&id=33666561>

Provides high-quality services to investigators and supports the substantial growth of epidemiologic and other population-based research projects. These services eliminates overlap in the collection and processing of survey data and biologic samples, staff training, subject recruitment, enhances quality control protocols and allows Cancer Center members access to significant expertise and experience in epidemiologic research in a cost-efficient and cost-reducing manner.

Contact:

Quiyin Cai – Director, Biospecimen Core

qiuyin.cai@Vanderbilt.Edu

&

Martha Shrubsole – Director, Survey Research Core

martha.shrubsole@vanderbilt.edu

Tissue/Serum Proteomics Core

<http://www.mc.vanderbilt.edu/root/vumc.php?site=msrc/tissuecore>

Offers a variety of services in order to determine the proteomic profiles of tissue, serum, and other biological fluids using MALDI mass spectrometry. The services offered by the Tissue/Serum Proteomics Core include tissue profiling, tissue imaging, 1D and 2D robotic biofluid fractionation and protein profiling, and multidimensional LC-MS/MS “shotgun” proteomics analysis of biofluids and tissue homogenates.

Contact:

Richard Caprioli, Director
r.caprioli@vanderbilt.edu

Transgenic Mouse / ES Cell Shared Resources

<http://www.vanderbiltresearch.org/community/profile/id/8>

Assists investigators in generating, maintaining and storing germline-altered mice. The services offered include gene targeting, pronuclear DNA microinjections, ES cell microinjection into blastocysts, assisted reproduction, embryo cryopreservation and long-term storage, and use of microinjection equipment.

Contact:

Jennifer Skelton, Managing Director
Jennifer.Skelton@Vanderbilt.Edu

Translational Pathology Shared Resource

<http://www.mc.vanderbilt.edu/root/vumc.php?site=tpsr>

Provides access to human tissue samples, histology services, and specialized equipment to researchers. Human tissues are collected prospectively from routine surgical resections and autopsies for use by investigators in basic, translational, and clinical research studies. These tissues are available fresh, snap frozen, or in a variety of fixatives as requested by the investigator. Normal, neoplastic, and other diseased tissues are available for study.

Contact:

Megan Cook, Manager
megan.m.cook@vanderbilt.edu

Zebrafish Aquatic facility

The zebrafish facility is composed of approximately 100 research tanks available for short and long-term studies, and a significant expansion project is underway. The facility enables investigator access to the unique advantages of the zebrafish model, which provides hundreds of mutant and transgenic zebrafish with unique properties suited for specific experiments.

Contact:

Ela Knapik, Director
ela.knapik@Vanderbilt.Edu

RESEARCH CENTERS

Center for Human Genetics Research (CHGR)

<http://chgr.mc.vanderbilt.edu/>

The CHGR houses three core facilities: the Computational Genomics Core (CGC), the DNA Resources Core, and the Genetic Studies Ascertainment Core (GSAC). Working in tandem, these cores support the software development, genotyping, and study design needs of investigators researching the genetics underlying human disease. Because of the long-standing and extensive expertise of these cores, this study has high likelihood of producing successful research.

Center for Matrix Biology

<http://www.mc.vanderbilt.edu/cmb/>

Vanderbilt scientists who work on extracellular matrix biology have come together at the Center for Matrix Biology. The Center fosters cohesive interactions and collaborations between scientists with interests in angiogenesis, biomaterials, diabetic complications, fibrosis, tissue regeneration, tumor microenvironment, and wound repair.

Center in Molecular Toxicology

<http://www.toxicology.mc.vanderbilt.edu/>

The Center in Molecular Toxicology aims to understand the toxic effects of environmental agents at the chemical and biochemical level. Faculty affiliates of the interdepartmental program are drawn from the Departments of Biochemistry, Chemistry, Medicine, Pathology, Pediatrics, and Pharmacology to apply their knowledge of chemistry and biochemistry to understand and develop preventative measures for human disease.

Center for Structural Biology

<http://structbio.vanderbilt.edu/>

Vanderbilt's Center for Structural Biology is dedicated to enabling and proliferating research with the goal of determining the 3D structure of biological macromolecules at or near atomic resolution. Participating researchers have access to protein expression and purification, crystallography, NMR, and molecular graphics core facilities to aid in the determination of biomacromolecular structure.

Diabetes Research and Training Center (DRTC)

<http://www.vanderbilthealth.com/diabetes/12496>

The DRTC was established to conduct research and training in diabetes mellitus and related endocrine and metabolic disorders. Vanderbilt's DRTC has 95 participating faculty members from 14 departments in two schools and three colleges of the University. Research interests of biomedical scientists in the DRTC include *in vivo* metabolism, signal transduction, etiology and complications, gene regulation, and beta cell function. DRTC investigators are supported by a Surgical and Analytical Services Core, and by the Cell and Molecular Biology Services Core.

Digestive Disease Research Center (DDRC)

<http://www.mc.vanderbilt.edu/root/vumc.php?site=ddrc>

The DDRC was developed to promote research of digestive diseases in an integrative, collaborative, and multidisciplinary manner. The Center brings together faculty whose research falls into several areas of interest: GI physiology and metabolism, maintenance of epithelial integrity, enteric neuroscience, or regulation of growth, proliferation, and apoptosis.

Informatics Center

<http://informatics.mc.vanderbilt.edu/>

Unique among academic health centers, Vanderbilt University's Informatics Center is responsible for providing the essential information infrastructure for patient care, management, research, and education. By fusing scholarly research in biomedical informatics with the dissemination of knowledge to individuals, the Informatics Center has generated a number of internationally known products used to access and manage patient medical records.

John F. Kennedy Center for Research on Human Development

<http://kc.vanderbilt.edu/kennedy/>

The Kennedy Center mission is to improve the quality of life of persons with disorders of thinking, learning, perception, communication, mood and emotion caused by disruption of normal development. The Center brings together scientists and practitioners from the Medical Center, College of Arts and Sciences, and Peabody College to solve the mysteries of development and learning. Major research areas of Center faculty include communication and learning, developmental neurobiology and brain plasticity, mood and emotion, and family research

Mass Spectrometry Research Center (MSRC)

<http://www.mc.vanderbilt.edu/msrc/>

The MSRC has developed into a world-class research facility with state-of-the-art technologies, highly-skilled personnel and an array of instrumentation not found in any other academic institution. The mission of the Mass Spectrometry Research Center is to bring cutting edge mass spectrometry expertise, methodology, and instrumentation to the research and clinical infrastructure of the Vanderbilt University Medical Center.

Program in Developmental Biology

<http://www.mc.vanderbilt.edu/devbio>

Over 300 researchers, postdoctoral fellows, graduate students, and support personnel have come together to form the Program in Developmental Biology. The Program sponsors courses, research seminars, journal clubs, and an annual retreat to pursue an understanding of pattern formation and cellular differentiation and morphogenesis during the developmental process.

Vanderbilt Brain Institute (VBI)

<http://braininstitute.vanderbilt.edu/index.php>

The VBI was founded in 1999 as a transinstitutional entity to oversee and facilitate the extensive neuroscience-related endeavors carried out on the Vanderbilt campuses. Its primary mission is to promote research, education and training in the brain-related disciplines here at Vanderbilt, with the stated goal of fostering excellence in each of these arenas. One of the primary responsibilities of the VBI is to administer the Neuroscience Graduate Program. The Program has two major emphasis areas: Cellular & Molecular Neuroscience and Cognitive & Systems Neuroscience, and offers research opportunities that span the breadth of contemporary neuroscience.

Vanderbilt Center for Stem Cell Biology

<http://www.vanderbiltresearch.org/community/profile/id/3>

The Vanderbilt Center for Stem Cell Biology aims to understand the biology of stem cells and the mechanisms for directing their differentiation to specific cell fates. It is home to the Beta Cell Biology Consortium, a group of scientists dedicated to learning how to make pancreatic beta, which are destroyed in Type 1 diabetes, from embryonic stem cells.

Vanderbilt-Ingram Cancer Center (VICC)

<http://www.vicc.org/>

The mission of the VICC is to alleviate cancer death and suffering through pioneering research, innovative clinical trials, evidence-based patient-centered care, prevention, education, and community activities. VICC is a matrix center within Vanderbilt University Medical Center that integrates the cancer-related expertise and resource of the School of Medicine, Nursing, Arts and Sciences, Engineering, Peabody School of Education and the fully integrated Veterans Administration Medical Center. Most facilities are located on one campus, which promotes interactions, sharing of resources and collaborations.

Vanderbilt Institute of Chemical Biology (VICB)

<http://www.vanderbilt.edu/vicb/index.html>

VICB research spans a broad range of interests and is characterized by interdisciplinary and cross-disciplinary approaches. Many VICB members have affiliations with other key institutes and centers at Vanderbilt, including the Vanderbilt Ingram Cancer Center (VICC) the Institute of Imaging Science (VUIIS), the Center for Structural Biology (CSB), the Mass Spectrometry Research Center (MSRC) and the Institute of Nanoscale Science and Engineering (VINSE). All investigators have access to VICB core facilities that provide chemical synthesis, high throughput screening, antibody production, and small molecule NMR services.

Vanderbilt Institute for Clinical and Translational Research (VICTR)

<http://www.mc.vanderbilt.edu/victr/pub/>

VICTR is Vanderbilt's virtual home for clinical and translational research. Supported by the Vanderbilt Office of Research and the NIH sponsored Clinical and Translational Science Award (CTSA), the mission of the institute is to transform the way ideas and research discoveries make their way from origin to patient care. This is accomplished using a multi-faceted approach: through collaboration with a wide variety of research partners; by training, nurturing and rewarding participating researchers; by funding research; by developing new and innovative ways to involve the community in research; by developing new informatics and biostatistical systems; and by making available the latest technologies and sound research results affecting patient care.

Vanderbilt University Institute of Imaging Science (VUIIS)

<http://www.vuiis.vanderbilt.edu/about.php>

VUIIS supports advances in physics, engineering, computing and other clinical and basic sciences for the development and application of new and enhanced imaging techniques to address problems in biology and medicine, in health and disease. Faculty and trainees pursue research in developing new imaging methods and techniques, as well as in diverse applications. The addition of a 7 tesla magnet, one of only about eight in the United States, has enabled researchers to generate images down to the molecular level and will ensure Vanderbilt remains at the forefront of research in magnetic imaging. Some of the core areas of current interest are the development of methods for the assessment of structure, function, and metabolism including imaging in broad areas such as cancer, brain physiology, transgenic mice, cellular and molecular as well as research into the physics of imaging and spectrometry. The Institute also provides an exemplary training environment for postdoctoral fellow, graduate and medical students and undergraduates.

Vanderbilt Center for Neuroscience Drug Discovery (VCNDD)

<http://www.vcndd.com/index.php>

The Vanderbilt Center for Neuroscience Drug Discovery (VCNDD) extends traditional academic pursuits in basic science to take the most exciting advances in our understanding of human disease and drug targets to a point where these breakthroughs can directly impact patient care, especially focused on discovery of new treatment strategies for the most serious of brain disorders. The Vanderbilt Center for Neuroscience Drug Discovery is staffed by dozens of scientists, most of which bring industry experience to this collaborative, academic setting. Since 2007, VCNDD has made significant progress in finding treatments and possible cures for neurological disorders such as Fragile X syndrome, schizophrenia, dystonia, Parkinson's disease, Alzheimer's disease, and post-traumatic stress disorder. VCNDD research is currently funded publicly by the NIMH, NIDA, and NINDS, as well as privately by the Michael J Fox Foundation, Seaside Therapeutics, Johnson & Johnson, and other foundation and corporate partners.

Appendix III – 2008 Basic Science Foundations Full Reports

To accomplish planning for the foundations of basic science strategic plan, six committees (see Appendix IV) met and interacted through the Fall of 2007 and the Spring of 2008 and solicited input from their faculty colleagues across the campus. They developed and honed a preliminary set of must-do's based on these deliberations and interactions. This preliminary set of must-do's was vetted with faculty through two Town Hall meetings in late Spring 2008, and through an open blog available for comments for anyone at Vanderbilt. From this careful, extended discussion amongst the faculty, detailed original must-do proposals from each committee were completed. These original versions are fully contained below.

A further series of meetings were held in the summer/fall of 2008 with the committee leaders, and the below detailed proposals were distilled into a core set of prioritized objectives and must-do's. Only the prioritized must-do's are included in the formal strategic plan. Due to this, there are differences between the below original must-do's and the prioritized must-do's.

Enhancing Communication Committee Reports MUST-DO's

It seems self evident that effective communication provides a sound foundation for efficient development of any institutional initiative. However, consultations with Medical School and Nursing faculty members engaged in basic science research revealed significant dissatisfaction in several areas related to communication. Undoubtedly, the communication problems have arisen in part due to rapid growth of the institution over the last decade. The feedback clearly directed a focus on four themes: 1) faculty-administration communications, 2) VUMC web site issues, 3) regulatory requirements/burdens, and 4) mass email communications.

MUST-DO TASK 1

Appoint a faculty-nominated ombudsman to facilitate effective mechanisms for bidirectional communications between general faculty and administration.

Clear explanations from administrators about the reasons for leadership decisions help faculty members understand and accept the decision, even if not desired, and/or any delays in promised actions. Vice-versa, clear lines for communication of faculty ideas to the administration are needed to ensure that faculty members feel that their viewpoints are fully considered during deliberative processes. Historically the administration has relied on department chairs and center directors to communicate information, but the success of this approach has been spotty. In addition, faculty members are typically unsure which administrative leaders should be approached with ideas, problems, questions, etc, leading to some frustration. Recent events suggest that the current administration recognizes the problems and has intentions of making substantive changes. These include initiation of this revision to the Strategic Plan, recent "town hall" discussions between senior administrative leaders and groups of rank and file faculty members, and establishment of the "Blogging at the Medical Center" web site. Nevertheless, this issue cannot be quickly "fixed" by a "must-do" action point (or even points). Rather, establishing the desired goal will require sustained commitment to a different mode of ongoing operations, with slow but steady adaptive changes throughout the Vanderbilt "culture".

We envisage that a faculty "ombudsman" will serve as a "point-person" in D3300, effectively becoming a bi-directional conduit of information between faculty and administration. The position should be the major time commitment (>50% effort) of an individual holding a Ph.D. with considerable direct experience in basic science research as the PI of RO1s or equivalent grants at Vanderbilt, and a good working knowledge of institutional organization and the current faculty. The Ombudsman should be nominated, and perhaps elected, by the faculty. We anticipate that s/he will play a key role in helping to implement recommendations in the Strategic Plan. A committee of basic science faculty and administration

representatives should develop specific criteria for selection of this individual and implementation of this recommendation. We suggest several mechanisms for the Ombudsman to communicate between faculty and administrative leaders.

1. Enhance annual state of the institution presentations to increase information content relevant to the basic science research enterprise. Current “State of VUMC” addresses are so heavily biased toward the clinical enterprise that few basic science faculty members are motivated to attend. While these addresses should be re-focused to provide more balanced coverage, we feel that it is also necessary to initiate a second parallel address, perhaps delivered by the Associate Vice Chancellor for Research and the Ombudsman, which would invert this balance: summarize the status of the clinical enterprise, followed by detailed discussion of issues important to basic sciences (e.g., research cores, educational programs, grant funding, basic science investments, faculty growth, technology transfer, Institutes and Centers). These additional presentations might be considered as a parallel to the ongoing Vanderbilt Medical Group meeting series which focus on clinical matters.
2. Expand departmental visits by senior administrative leaders. To supplement one-way communications inherent to State of the Research Enterprise presentations, administrative leaders should meet in round-table or town-hall style settings with faculty from at least one basic science department (or research center) each month year round. This will allow faculty members of all ranks the opportunity to engage in discussions with institutional leaders. Basic scientists with primary appointments in clinical departments should be invited to participate in these discussions, perhaps via basic science departments in which they may have secondary appointments, or research centers to which they are affiliated. Some leaders have made recent efforts to do this, and faculty members uniformly perceive this as a positive experience.
3. Continue to experiment with new ways of facilitating communications. For example, the recent implementation of “Blogging the Medical Center” is a promising mechanism to solicit input/feedback. However, there are reservations about whether faculty members will have time to read and/or write blogs, and some questioned how (or even if) this information will be utilized. In addition, the current lack of anonymity may mean that some individuals (e.g., junior faculty members) are reluctant to post serious criticisms (use of VUnetID means that all comments can be traced to the author). Thus, some individuals, perhaps cynically, saw the blog site as a way of gathering largely positive feedback to justify current directions. In addition, it was disturbing that the Basic Science Planning Town Hall Meeting feedback blog site never appeared as an option on the general VUMC Blogging site (despite a request to correct this), limiting feedback from a larger group of faculty. Nevertheless, on balance, further development of this idea by tweaking the system to facilitate its utility might be worthwhile. For example, a dedicated anonymous “Basic Research” blog moderated by the ombudsman might be more effective. However, even at its best, blogging can only be one component of a larger effort to improve communications.

MUST-DO TASK 2

Consolidate, integrate and expand support for enhanced web-based and email communications across the entire institution, engaging a basic science faculty advisory committee to help guide these efforts.

The current lack of utility, inconsistency and poor maintenance of VUMC web sites pertaining to the basic science research enterprise is in contrast to web offerings for patients/visitors. Of particular note, the default search engine (Ultraseek) consistently returns limited information, often seemingly limited to old “Reporter” articles and it is often more effective to searching the entire WWW using Google. Internal search engines should identify faculty web pages maintained by the BRET system, lab home pages, relevant departments and centers. In addition, there is considerable frustration with the profusion of banal messages circulated via VUMC Email, especially from Medical Center Communications. While the importance of having the capability to broadcast important messages campus-wide is recognized, the impact of these messages is diluted by a mass of unimportant ones. Messages from Medical Center

Communications are often automatically deleted so that important messages are not read. In addition, there is a critical need for easier access to information to facilitate exchange of research reagents (e.g., transgenic mice, antibodies) and expertise within the Medical Center, perhaps interfacing with a Laboratory Information Management system similar to that being used in the Center for Stem Cell Biology and the Beta Cell Biology Consortium. Solutions to this last problem are presented elsewhere in the strategic plan, although we fully concur with the need to attend to this issue.

A functional web presence for basic science is a critical vehicle to communicate our discoveries to the outside world, and also to facilitate communications between basic scientists on campus. Ongoing web development efforts in different parts of the medical center (e.g., BRET Office, Office of Research, School of Medicine) seem to operate autonomously, without a cohesive overall plan. Significantly, we are unaware of efforts to engage research scientists to help in the redesign, improvement and customization for the desired purposes. Lastly, the speed of the web site redesign/update process often moves at a glacial pace, indicative of poor central support to departments and labs for these purposes. Therefore, there is a critical need for a dramatic increase of support for consolidation and centralization of web development projects, implementing a trans-institutional strategy in order to minimize duplication of effort, inefficiency, and complexity.

The IT office should be staffed at a level where it can be proactive in reviewing and updating department and laboratory web pages across the Medical Center. In addition, an advisory committee containing researchers from across the entire institution (i.e. VUMC, SOM, and University Central) should be established to help guide and focus the IT effort in areas that will be of maximum utility to the research enterprise. This effort should recognize that the utility of web pages to internal users may be different than the utility to members of the public trying to learn more about research at Vanderbilt. Part of this effort should involve redesign of the Vanderbilt search engines from the ground up. Related web pages should be linked so that topics can be progressively pursued in greater depth. For example, online Reporter articles that might be accessed first from off campus should contain links to lab- or PI-specific home pages, home departments or research centers. The idea of allowing internal users to personalize content on a “home page” (as is possible at the Google web site) may have merit and also should be explored – this may be a version of the myVU page recently implemented by University Central.

Related to this effort, there is a need to revamp the distribution of seminar notices. Several overlapping systems are currently involved and faculty members receive seminar notice emails from several sources. Much of the information within those emails is redundant, and it is left to the individual to filter. The BRET office has become a useful resource for compiling Medical Center seminar information, but this is often incomplete or incorrect, and does not appear to allow inclusion of events from other schools. The Vanderbilt Calendar has a very useful feature of allowing one to automatically add seminars of interest to ones electronic calendar. However, in this case one has to manually move through dozens of other events irrelevant to that individual (e.g. start of exam period, end of a summer session, an art exhibit, etc). So, no one current system meets the need. We recommend that the Calendar should be modified to allow users to select the types of event that are displayed at any one time (e.g., all research seminars but not athletic events, etc) – the customizable calendar should be one option for inclusion on the personalized home web page mentioned in the preceding section. All administrative units must be required to ensure that complete seminar information is listed on the central University Calendar.

Lastly, substantial efforts should be directed to increase the quality of email communication with concomitant decreases in the quantity, increasing the efficacy of essential emergency messages. Recent implementation of twice-weekly compilations of Medical Center Communications appears to be a step in the right direction, but may need some tweaking because an initial response suggests that this will negatively impact recruitment of participants in clinical research studies. We strongly recommend that the Email system be modified so that “community messages” are assigned to different categories (e.g., Emergency, Regulatory, Clinical, Research Announcements, Social Events, Fundraising, Clinical Trial Volunteers, etc). Users (recipients) of the email system should then be provided the opportunity to “opt-out” of receiving messages in identified categories (recognizing that it should not be possible to opt out of messages in some categories). Senders of these messages will then have to be trained to appropriately assign messages to the various categories before sending. Similar approaches should be used within smaller units with the university.

MUST-DO TASK 3

Establish a working group of faculty representatives to develop ways of minimizing regulatory burdens on faculty time/effort.

In a time of increasing demands for time and resources, most basic scientists feel the impact of increasing regulatory burdens from multiple sources (e.g. EHS, Occupational Health, DAC, IACUC, IRB, Procurement, CORES), representing a substantial drain on faculty time/effort. We need to empower a culture where these demands are as easy as possible for our faculty to meet. Recent development of electronic formats for many of these requirements should facilitate this process, but some systems do not appear to communicate with others. As one example, the FOTO and EHS systems are not well coordinated. This issue gets worse when crossing from VUMC to University Central. All Vanderbilt regulatory compliance units need to receive explicit directives to provide for appropriate sharing of confidential and/or sensitive data in order to assist the faculty in regulatory compliance. The streamlining of these efforts should be overseen by a task force committee containing representatives from the major regulatory units as well as faculty members representing diverse areas of the research enterprise. Their goal should be to minimize regulatory burdens on an ongoing basis.

Sharing Research Information Committee Report MUST-DOs

This committee focused on methods and procedures that would facilitate sharing of key research information, equipment, and reagents among labs at Vanderbilt. Such collegial sharing has been a hallmark of the institution, but with the astounding growth over the last decade, it is beyond the scope of individuals or even departments to keep track of what is available throughout our labs. This results in needless duplication of effort, which in turn, lowers our productivity and competitiveness. A simple and comprehensive sharing system will allow us to leverage new projects off of established ones in a way that makes the whole greater than the sum of the parts.

MUST-DO TASK 1

Develop an in-house searchable database that contains VU specific research information.

This database should be populated from data sources that are already available (e.g., Coeus, PubMed, VU-OTTED) so that the effort required from investigators is minimal. Because of the tremendous growth of the Vanderbilt research enterprise, no one is able to keep up with what is going on. Thus, there is a pressing need for mechanisms to boost our understanding about what our colleagues are doing, and also learn what equipment, reagents, and expertise is available locally. This will greatly enhance our ability to move our own research forward and facilitate the formation of multi-component research projects.

This database should include information on:

- grants (taken from the Coeus system)
- manuscripts (taken from PubMed or ISI)
- published abstracts (taken from on-line searches of national meetings)
- technology transfer disclosures (taken from the OTTED database)
- clinical trials (taken from the VICTR database)
- available research tools including antibodies, major equipment, and animal models (this data could be extracted from e-procurement, purchasing, and IACUC databases)
- software (taken from e-procurement and ITS databases)
- outside activities of our colleagues such as editorial and advisory board memberships while some of this might come from on-line searches and the public affairs office, this would likely require some direct effort on the part of investigators.

To protect any proprietary information, the search should be accessible only via a VU IP address or VPN connection (similar to ACORN and on-line journals). In the future, this system could also be linked to lab management systems for keyword searches, which would access text within lab notebooks, and identify the most likely labs to find expertise in a given area of research.

As an added benefit, this search engine should run from a VU Research Home Page that would have many useful links for investigators (e.g., HR, People Finder, PubMed, the NIH Commons, VUMC Office of Research). This home page could have links to recent news stories and rotating content, and could be used as yet one more vehicle for communication among the faculty and between the administration and the faculty. A good example for this is the VU Home Page which has links and rotating news content, but this new page would be specific for VUMC researchers.

MUST-DO TASK 2

Develop new infrastructure and administrative models for the basic sciences.

Clinical and translational research is being supported by VICTR infrastructure, which has led to significant gains in these research areas, but similar basic research needs are unmet. For translational support, we have the CTSA and an extensive infrastructure developed by Dr. Bernard's team in the Office of Research. In many ways, basic research needs a parallel infrastructure to support its mission, but such support does not currently exist except for a few exceptions (e.g., the core lab management system). Further, there is a current disconnect between basic scientists and the Medical Center leadership. This issue is exacerbated by a lack of closeness between basic research in clinical departments and that in the basic science departments. The medical center leadership should consider an administrative structure that will facilitate meeting of needs of basic researchers throughout the Medical Center, especially in developing new programs and performing the kind of coordinated recruiting across departments needed to build such programs. One key point is that this structure must be accompanied by resources sufficient to seed such program building. Whatever structure is adopted, the leadership must avoid *the temptation to create a "one size fits all" solution; this must be basic science specific*. It is generally acknowledged by all participants in this planning process that the VICTR model, while highly effective for clinical and translational research, would be insufficient to address most issues faced by the basic scientists.

It should be added that one related issue raised during the planning process was that many departments have an unacceptable web presence. We were pleased to learn that VUMC, through Med Center Communications, now offers access to a basic, simple template to create and update an attractive web site. - a program called Site Builder. This new version has been enthusiastically received by those who have used it, and represents the kind of modest, yet high-impact investment that we are advocating in this plan.

Measuring Progress Committee Report MUST-DO's

Vanderbilt University aspires to gain a place among the world's elite institutions in the area of biomedical research. Accomplishing this goal will require an unwavering commitment to basic research, and maintenance of the present excellence in parallel with development of an even higher profile basic sciences faculty. Attainment of these goals would be reflected by increased representation in the National Academy of Sciences and the Howard Hughes Medical Institute, and by improvements in other impact and prestige factors. The development of an ever more eminent faculty is deemed to be closely linked to an increase in the number of papers in the highest visibility journals. The committee concluded that attainment of these goals will require a new philosophy of what is "progress", and vigilant monitoring at different levels of VUMC. In simplified form, the committee's view can be summarized as:

MUST-DO TASK 1

At the levels of Institution, institutional leaders /managers, and Departments/Centers/Programs, define excellence and measure progress in terms of what is produced, and only secondarily in terms of aggregate revenue (aggregate grant dollars; licensing dollars, etc).

The Measuring Progress committee recognized three underlying principles for this must-do task:

1. The most important level at which to measure progress is on an VUMC institution-wide basis (all administrative levels above departments/centers/programs). However, it is also vital that robust measurements are in place at the levels of leadership of Departments/Centers/Programs.
2. Far more weight needs to be given to outcome measurements normalized on a per faculty basis rather than on total grant dollars, which are perceived as the over-riding or exclusive consideration at present.
3. While focusing on perceived weaknesses or areas most in need of progress and growth, VUMC needs to support and sustain current areas of excellence. Vanderbilt's recent success in garnering NIH support draws on institutional strengths. These include our unified campus, a culture of collegiality and cooperativity, wise strategic investments, and excellent faculty. Moreover, a variety of the different "market basket analyses" that rate faculty productivity (e.g., Academic Analytics) or schools/institutions (US News, etc) all rank Vanderbilt highly. In aiming toward our lofty goals, we must avoid doing so at the expense of our current strengths. In particular, when evaluating individual faculty it must be recognized that there are numerous acceptable models for what constitutes professional success. For example, many successful faculty doing research that ultimately has high impact do not publish in high visibility journals.

The Measuring Progress committee had further extensive thoughts on the specific targets and measurements for a focus on impact. These were targeted to three general arenas:

1. Institutional Benchmarks for Impact

A. Training & Development mission: Premise: One of the four main areas where a university has impact is through the education and training of future leaders and scientists, and this area is one where ONLY universities are a major force. Progress in this education and training mission should be measured in terms of aiming for the top, as assessed versus the performance of the very best universities in the world. An additional and under-served aspect of university impact lies in the ongoing development of its faculty.

To this end, we recommend that progress in TRAINING should be scored exclusively on increasing the percentages of

- (1). doctoral graduates who:
 - i. publish 1st authored papers in top journals based on their Ph.D. research, and then proceed to
 - ii. publish substantive first-authored work in their post-doctoral research career
 - iii. eventually take faculty or science leadership positions in academe or 'industry'
- (2). post-doctoral fellows (Research fellows; MD and MD/PhD fellows) who:
 - i. take faculty or science leadership positions in academia or 'industry'
 - ii. publish substantive senior-author work or become PI's of research grants (R01 or true equivalent)

In the sphere of FACULTY outcomes, we recommend that progress in DEVELOPMENT should be scored on the basis of increasing percentages and numbers of faculty who are on editorial boards of the most high-visibility journals, organize national / international meetings , take national and international organizational leadership positions, and win national / international awards based on their research.

B. Discovery mission: Key benchmarks for measurement of progress are deemed to be:

- (1). Improved recruitment and retention of the most realistic ‘prospects’ or actual NAS / HHMI members – improved development of faculty who will be competitive for the ‘opinion-making’ journals, organization of conferences (national & international outside VU), and/or a future (or present) member of NAS.
- (2). Increasing productivity (all journals; focusing on work led at VU, i.e., first or last / senior authorship).
- (3). Increasing the numbers of research papers from VUMC that appear in the highest and most influential levels of journals.
- (4). Increasing numbers of patents
- (5). Increasing funding per faculty member.

2. Top Institutional leaders/managers Benchmarks for Impact:

- A. Improvements in institutional metrics defined in the preceding section (Institutional, 1 & 2)
- B. Success in improving basic science, research-intensive faculty satisfaction metrics, including but not limited to retention of the most productive faculty.
- C. Development & implementation of mechanisms whereby departments (Centers, and Programs) and their faculty, are rewarded for outstanding departmental performance by increased allocations, and are held accountable for their use of the enhanced resources. It was the understanding of the committee that while chairpersons are currently directly rewarded for outstanding performance, the department itself is often neglected in terms of enhanced allocations.
- D. Progressive and substantial improvement in fund-raising and growth of the medical school endowment.

3. Departments/Centers/Programs Benchmarks for Impact:

- A. Training mission: THE key benchmarks for progress at the level of the individual department / center / program should be progressive improvement in the same outcome metrics as are recommended for the institution in terms of Ph.D. students, post-docs, and faculty.
- B. Discovery mission:
 - (1.) Increasing success in recruitment and retention efforts directed towards developing faculty who are or will be competitive for the ‘opinion-making’ journals and/or a future (or present) member of the NAS or of the HHMI.
 - (2.) Increasing ‘catch rate’ (the percentage at which 1st choice candidates for faculty positions are successfully recruited).
 - (3.) Increasing faculty productivity [as judged by communicating-author publications, by the numbers of papers and appearing in high impact journals and, as currently practiced, funding per faculty]. No single criterion of increasing productivity should dominate or be the main basis for valuing faculty or judging increased success.

MUST-DO TASK 2

Preserve the best aspects of our institutional culture, while increasing breadth and amounts of investment in individual basic scientists as well as basic research innovation and new directions.

While focusing on perceived weaknesses or areas most in need of progress and growth, VUMC needs to support and sustain its current areas of excellence. Vanderbilt’s recent success in garnering NIH support draws on institutional strengths that reflect favorably on VU leadership. These include our unified campus, a culture of collegiality and cooperation, wise strategic investments, and excellent faculty. Moreover, a variety of the different “market basket analyses” that rate faculty productivity (e.g., Academic Analytics) or schools/institutions (US News, etc) all rank Vanderbilt highly. In aiming toward our lofty goals, we must avoid doing so at the expense of our current strengths.

MUST-DO TASK 3

Increase the representation of VUMC faculty as leading authors in the highest visibility journals and professional venues of science (HHMI; NAS; Pioneer & Eureka Awards).

The recent advance of biomedical research at VUMC has been impressive, as judged by the surge in NIH funding. Such progress is all the more notable in light of the crisis in NIH funding that has persisted for the past several years. This is much to the credit of the upper administration of the university who have made important and beneficial investments in areas such as pharmacogenetics, structural biology, neuroscience, and chemical biology. Nevertheless, Vanderbilt's prestige and impact in biomedical research falls short of its funding stature. Consider three examples of 'prestige endpoints' where Vanderbilt is found lacking.

- a. From January 2006 through November 2007, there was only one primary research paper in *Science* or *Nature* (out of ~ 2200 total papers in the biological sciences published in those journals) for which a VUMC researcher was 1st or last author. (16 such papers emanated from Duke).
- b. There are over 40 universities in the US with 10 or more members of the NAS (Duke has 18); Vanderbilt has 4, 3 of whom are no longer running active research programs.
- c. There are 31 institutions with 4 or more faculty with HHMI appointments; Vanderbilt has 1 (Duke, 7). Of 56 new HHMI appointments made in 2008, zero were Vanderbilt scholars.

Vanderbilt's acumen in clinical and translational research is impressive, as reflected by healthy representation in the Institute of Medicine. Vanderbilt's clinical enterprise is at the forefront of hospitals and medical care organizations. Moreover, there is a consensus that VUMC does a very good job at promoting and fostering "solid" research. These facts are laudable. Nevertheless, there is concern that the culture and investments of VUMC do not foster the pursuit of the highest visibility basic research, which often requires significant time to reach benchmarks (e.g., high impact publications) and can be high-risk in nature. A strong track record in high impact basic medical research, independent from obvious translational or clinical components, is paramount if VUMC is to attain national and international stature that meets the aspirations of Board of Trust.

Addendum

The Measuring Progress Committee chose to interpret its charge literally (what to measure) and focus most of its consideration on this issue, though many ideas emerged on the topic of "how to get there" (i.e., diverse means of moving to an even higher level of excellence, to the level indicated in the aspirational statement of the Board of Trust). Some questions arose during Town Hall meetings, however, on which committee thoughts on means to the end were solicited. Similarly, some recurrent issues surfaced in the blog that bear addressing.

1. In comments on rewarding Departments/Centers/Programs for progress or outstanding achievements, the committee recommends two separable points:
 - a. most importantly, provide rewards to the overall Department/Center/Program for superior progress, i.e., supplements to the annual allocation for new faculty recruitment, etc.
 - b. change how incentives (salary bonuses) are structured for Chairs/Directors/Programs, so that at least as much weight is given to targets that are based on 'output measurements' rather than solely on 'revenue measurements' (total grant dollars; IDC recovery; grant dollars per faculty; percent faculty supported at >70% of effort, etc).
2. Commentary from the Town Hall meetings and the blog underscores the importance of the "MUST DO" #2 and its underlying principle (support and sustain current areas of excellence). Leaders at all levels will need to finesse the balancing act of emphasizing the continued value and importance of productive faculty whose work has substantial impact without appearing in the highest visibility journals, while at the same time cultivating a culture change that fosters increased representation in top-visibility journals, HHMI, NAS, plenary presentations, etc. If the message were misinterpreted as 'only papers in *Science* and *Nature* matter', there is a high potential of more harm than benefit to the institution.

Remaining Competitive in Research Committee Reports

MUST-DOs

MUST-DO TASK 1

Invest in faculty with basic support to maintain flexibility of effort and heavy investment in new innovative investigator-initiated, projects.

As the competition for federal grant funding becomes tighter, the innovative nature of the research tends to lessen. With the addition of the stringent effort reporting requirements, the available time to spend on developing and writing new projects is severely compromised as well. The current bridge funding program is inadequate for faculty to initiate changes in research focus.

We have an innovative collaborative faculty who will use funds to do progressive world class research if their hands are untied. Fiscal trust is a key component to this issue. This will become a bigger issue as the regulatory burdens increase on effort reporting. A basic level of support is probably necessary to give flexibility to pursue new and novel research.

We recommend funding for faculty to provide basic flexible support to pursue new ideas and develop collaborative goals and projects. This is a shift from investing in projects and physical facilities. In addition, a significant increase in the current discovery program is envisioned. A new discovery grant program should be flexible, have a minimum review with a very short turn-around between grant submission and funding decision. The major review criteria should be feasibility and we must be willing to accept a high failure rate of these projects as the price of innovation. In addition, it will be important to maintain a periodic review of results using output metrics.

Sabbaticals provide opportunities for faculty to learn new technologies which can greatly enhance their research. Furthermore, often new technologies are brought to the campus via sabbatical leaves which can be used by several investigators. It is clear from the Faculty Manual that sabbatical leaves are permissible for Vanderbilt faculty, yet very few VUMC faculty take advantage of this opportunity. Such experiences should be encouraged by department chairs and institute/center directors when benefit to the faculty member's research is evident.

MUST-DO TASK 2

Prepare policies and support for trans-institutional centers and institutes for maturation

Multidisciplinary and trans-institutional centers/institutes (TCIs) are seen as crucial to being competitive. They provide the needed intellectual and instrumental infrastructure for successful cross collaboration within and across specialties. These centers are fairly easy to start but their long-term fate and that of the people in them is not clearly defined. Periodic investment in infrastructure is needed. Equipment, reagents, and expertise needed for these should be easy to find and readily accessible. There is a strong perception that the current system for rewarding participation does not carry to the department/division level. This poses a significant participation barrier to mid-level faculty who would be most useful to these entities.

There should be a transparent mechanism put in place to evaluate these centers. TCIs will be more successful and attractive to investigators if the rules/expectations/career incentives are clear. Inertia can carry TCI(s) past their useful life. Costs at all levels will be saved if human and capital resources are not duplicated.

Reward TCI participation with clear promotion effects, funding for mid-level faculty, and expectations. Develop a regular method for determining the lifespan of TCIs maintaining/growing the successful ones and pruning the ones that have faded or become less relevant. Scan for proto-TCIs from home grown efforts rather than just what other institutions are doing.. Rationalize the differences in procedures

between the main and medical campus. Finally a clear listing of skills/equipment/opportunities that is easy to find and navigate is essential.

MUST-DO TASK 3

Retain our best mid-career faculty

Faculty who are past their first few years but are not Center/Department/High Profile investigators need support and access to funds/resources. These are the people that contribute to a lot of the big collaborative projects underway in the Medical Center. These individuals are the most likely to be lured away at this time when they are least visible to administration. Replacement is much more expensive than retention of skilled productive personnel. We probably lose more people to inattention than to salary levels.

Develop a proactive regular review of mid-level faculty to assess satisfaction, needs, wants, and frustrations and fund it to meet needs. Stay at or ahead of the averages and national trends for compensation and resources. As described in the funding suggestions, make flexible funds for new development available. Enlarge our base of endowed chairs in basic sciences. Recognize team players and support roles both with advancement and resources.

MUST-DO TASK 4

Significantly reduce administrative burden and unfunded administrative mandates

With time any bureaucratic system becomes top heavy and unwieldy. The maze of regulatory groups, financial systems, technology transfer, contracts, IRBs, animal care, effort reporting, etc. have significantly “fouled” the bottom of the ship. Duplication of efforts is also becoming worse. The % of time investigators spend on these things is disproportionate to their research time and effects their effort reporting.

Efficiency and ease of use will save money, decrease frustration, increase tech transfer and private contracts, help with effort reporting, increase new research, and help with recruiting.

Carefully review these groups and requirements as a whole with an eye to reduction and streamlining. Carefully vet any new requirements. Reduce or eliminate “unfunded mandates” of administrative paperwork and requests. Make use of our excellent informatics to consolidate information so that duplication of effort is avoided. One stop shopping should be the rule and all administrative groups should crosstalk to so they know what each other is doing. What appears easy to find and reasonable to an administrator may not be to faculty unfamiliar with the process.

Graduate and Postdoctoral Education Committee Reports

MUST-DOs

Training the next generation of scientists is a key function of the Medical Center’s research enterprise. The enthusiasm and energy of graduate and postdoctoral trainees are the life blood of our research laboratories and the continued success of these trainees as they progress in their careers is used as an external measure of the success of our research enterprise. Given the importance of trainees in both generating and measuring our success, it is essential that we recruit and retain the best possible trainees. Over the last 15 years, Vanderbilt has been perceived as a leader in graduate education. The development of an interdisciplinary, umbrella mechanism for entry into Ph.D. granting programs was an innovation that has been widely discussed and reproduced throughout the nation. In response to faculty requests that the institution should increase efforts to identify and support trainees with strong physical

science backgrounds, the Chemical and Physical Biology Program was developed. Similarly, institutional commitment has allowed for expansion and improvement of the Medical Scientist Training Program. All of these efforts have supported unprecedented growth and improvement of Ph.D. and post-doctoral granting programs associated with medical school faculty.

With these recent successes as a strong foundation, the committee has focused on what should be the next key innovations in graduate and postdoctoral education to propel Vanderbilt at the forefront of biomedical research and training. Our first “must-do” outlines specific strategies to provide financial and logistical support to both stabilize our successful umbrella programs and to increase their ability to attract the best trainees. Our second “must-do” deals specifically with the Interdisciplinary Graduate Program which, at its inception over 15 years ago, was hailed as a major innovation in graduate education. The requested review of this program provides an opportunity for Vanderbilt to develop the next innovation in graduate education. Finally, our third “must-do” positions Vanderbilt to take advantage of the explosive growth of scientific opportunities outside of the United States. To be a global leader in biomedical science, Vanderbilt must attract and retain the best foreign trainees, forge partnerships with institutions overseas, and develop a worldwide reputation.

MUST-DO TASK 1

The umbrella programs that serve as entry points into Ph.D. granting programs should receive centralized funding directly from the administration.

The three current umbrella mechanisms that serve the Ph.D. granting programs are the Interdisciplinary Graduate Program (IGP), the Medical Scientist Training Program (MSTP), and the Chemical and Physical Biology (CPB) Program. The current mechanisms for funding each of these umbrellas present challenges to the organization, evaluation, and long term planning necessary to support each. Centralized funding of each of these components will facilitate the continued improvement and growth of these umbrella mechanisms.

In the case of the Interdisciplinary Graduate Program, the major mechanism providing students into Ph.D. granting programs, centralized funding will obviate the need for the current Departmental charge-back system. This change in policy will reduce attempts by members of individual Departments to shape IGP policy on pedagogy. Faculty are concerned that decisions both about class size and IGP Core Course content are made for reasons that do not serve either students or faculty. Centralized funding will also simplify issues related to determining class size. Given the competitiveness of obtaining extramural funding and the increased number of training mentors, and high quality research opportunities available for IGP students, the size of the IGP class should be directly linked to the number of faculty. All new research faculty hires should automatically translate into larger IGP class sizes; realistic multipliers should be used in this calculation. Many times highly qualified IGP applicants, both United States citizens and talented foreign students, are lost due to a lack of funding flexibility, both in offering students direct entry into individual laboratories or Departments and the constraints of NIH Training grant rules. To increase both the size and diversity of the IGP class the University should work with IGP faculty and the Biomedical Research Education and Training (BRET) office to immediately establish a substantial endowment to facilitate the funding of additional students, including direct admits into departments or programs, IGP topping-off awards, and recruitment of outstanding non-training grant eligible graduate students. The dispersal of these funds may be best administered by a committee composed of IGP faculty.

In the case of the MSTP, the current taxes on individual departments may limit the recruitment and funding of the best pool of students. Student recruitment into the MSTP should focus on the best possible class irrespective of the eventual scientific department or program selected to support Ph.D. studies. The CPB Program provides an important mechanism to support the recruitment of the best students in the physical sciences. Due to the trans-institutional nature of this program, funding mechanisms for the CPB program differ from IGP but this program would also benefit from centralized funding as it grows and matures.

MUST-DO TASK 2

The IGP should be subjected to both internal (short-term; within months) and external (within the year) review to critically assess IGP organization, IGP administration and IGP Core course content and duration. As part of the evaluation of course content, a set of well-defined core competencies should be developed for which all IGP students will be responsible.

As the major entry mechanism to graduate programs in the biomedical sciences, it is imperative that the IGP program and course be responsive to the needs of the Ph.D. granting programs. As part of the evaluation of course content, a set of well-defined core competencies should be developed for which all IGP students will be responsible. These core competencies should be targeted to provide a solid basis for continuing studies in any of the Ph.D. granting programs. These core competencies may also allow for the development of a testing strategy for incoming IGP students related to this core knowledge that would allow the identification of more advanced students who may be allowed to move directly into basic science training programs and/or to more advanced portions of their didactic training. In addition to evaluation of the rigor and intensity of the IGP Core course, the Flextime Discussion component of the course should be carefully evaluated for content and a particular emphasis placed on more 'active learning' wherever feasible. In order to implement curriculum and structural changes the Director of the IGP should have greater authority and independence from the BRET office to mold, modify and shape the program. In order to attract the best teachers and mentors into the IGP curriculum the administration should identify and appropriately remunerate *Master Basic Science Teachers* who will play key roles in teaching the IGP Core Course.

MUST-DO TASK 3

There be established a liaison officer between the Graduate School and the International Office with the goals of forming alliances with international universities to recruit the best graduate students, expand Vanderbilt's visibility, and facilitate scholar exchange programs.

To be a truly great University Vanderbilt must be a diverse community of scholars and advance a reputation outside of the United States. This new office would coordinate and lead efforts to build a global presence. First and foremost ways to support non-US trainees must be provided as this is the biggest obstacle in terms of recruiting non-US students to Vanderbilt. To this end, the University should establish an institutionally funded training grant. Training slots on this competitive program (approximately 8) should be unrestricted with the aim to attract the very best graduate students regardless of their nationality or current place of residence. In addition, it would be desirable to establish international scholarships. The availability of a "Vanderbilt Scholars" program, in addition to bringing highly qualified pre- and postdoctoral trainees to Vanderbilt, would increase Vanderbilt's visibility globally. Since it is often difficult to evaluate non-US candidates, this office could coordinate recruiters who perform interviews in person in some of the key countries (ie, China, India) and involve alumni from our programs who are located in foreign countries in this process. For our existing trainees and alumni it may be useful to map the university from which they came to their performance at Vanderbilt in order to predict the quality of trainees from various schools. Faculty, fellows, and current graduate students, especially those who are from countries of interest, could be involved in the process of evaluating candidates.

Finally, this office must address the issue of name recognition abroad. This will ensure that we will have the best and brightest students apply to our Graduate and postdoctoral Programs. One mechanism to increase visibility is the "Vanderbilt Scholars" program suggested above. Other mechanisms may include the Establishment of a focused international speaker seminar. This will engage high level researchers at targeted universities, increase their familiarity with Vanderbilt, and may result in their students being targeted to Vanderbilt. Efforts to enhance our web presence should continue to be an area of focus. Once we recruit trainees, we must do a better job of accommodating non-US trainees, especially students, once they arrive in Nashville. Issues to address include: housing assistance, assistance in obtaining social security numbers, bank accounts, driver's licenses, transportation from the airport, and other logistics.

MUST-DO TASK 4

There be established a "Postdoctoral Symposium" to be held annually where selected graduate students from across the nation will be brought to Vanderbilt and recruited as postdoctoral fellows.

The best postdoctoral trainees bring new skills and insights to the research enterprise, tackle significant and often high risk research problems, and increase Vanderbilt's visibility by being highly sought after for faculty and industry positions. A "Postdoctoral Symposium" as a mechanism to recruit postdoctoral trainees is used by the National Institutes of Health and several academic institutions. These programs provide a model that Vanderbilt can use to increase the recruitment of the best postdoctoral fellows. In order to maximize the impact and effectiveness of the "symposium" a committee composed of faculty trainers, including representatives who are principal investigators on postdoctoral training grants, should work with the BRET office to plan the specifics of this event. Importantly, this group should critically monitor the effectiveness of this recruitment effort using outcome measures that might include monitoring the publication record and grant award record of fellows recruited by the "symposium".

To take full advantage of the enhanced pool of postdoctoral applicants provided by the "symposium" the current postdoctoral fellow "topping off award" program must be expanded. Currently, only \$36,000 per year is used to provide twelve, one time awards of \$3000 to qualified postdoctoral fellows and many faculty members are unaware of the availability of these awards. The visibility of these awards, to faculty members and potential postdoctoral fellows, the number, and the amount of these awards must be increased. To further the impact of these awards it is recommended that the awards be given with a designation such as "Vanderbilt Biomedical Scholar" which provides a distinction to the trainee and can be used in advertising the program to increase Vanderbilt's exposure nationally. These awards will act in conjunction with the "Postdoctoral Symposium" to attract and recruit the best postdoctoral candidates.

Summary

The committee discussed several additional items and some aspects of this discussion do deserve mention. Specifically deserving of mention are areas where the general perception of the committee was that significant progress has been made and that these efforts should be maintained. One area where the efforts of the administration have made a significant impact is postdoctoral training. The establishment of the postdoctoral affairs office has given postdoctoral trainees a voice in several key areas including benefits, salary scale, professional development, and career counseling. These efforts have made for significant improvements in our ability to attract and retain postdoctoral fellows. A second area is minority recruitment. Efforts to increase diversity in our trainees have increased the participation of underrepresented groups and allowed Vanderbilt to be seen as a supportive environment for trainees from across all areas of society. These efforts should continue to be a priority. With this in mind, enhanced efforts to recruit underrepresented faculty must be redoubled.

Addendum

In September 2008, the committee leadership provided additional response to the petition for Master Basic Science Teacher in their original must-do task 2, and proposed that this initiative replace their former must-do task 4 as:

Identify and appropriately remunerate faculty who will play key roles in teaching in graduate programs.

Involvement of faculty in all phases of graduate curriculum, beginning in the IGP year and sustained throughout the subsequent years spent in the Ph.D. granting programs, is critical to the success of Ph.D. training in the Medical Center. Recent curriculum redesign in the Medical School has recognized the contributions of faculty in settings ranging from large didactic sessions to small groups discussions and practicals. This recognition has taken many forms including a new system to provide financial compensation for time away from other duties. With respect to graduate education, we find ourselves in a situation where the size of the graduate program has, and continues, to increase in an environment where basic scientists are held to stringent effort reporting requirements. This environment may eventually limit the ability to recruit and retain the best teaching faculty. A concerted effort to identify and remunerate effective teachers will support program growth and quality.

Enhancing the Reputation of Vanderbilt Research Committee Report MUST-DOs

The Enhancing Reputation Committee focused on a number of questions:

- How can our research excellence in specific areas be made more visible at the national and international level?
- How can we increase our scientific impact?
- In the last 5 years, we have made excellent progress with expanding the number of IOM members on the medical faculty, but little or no progress has been made with organizations primarily focused on basic science, such as the NAS and HHMI. While the Discovery Lecture series is now bringing many such individuals to campus, how could we make more rapid progress with expanding our membership in these organizations? Should we have a standing “awards” committee that would identify specific candidates in advance, and work with them to build their portfolio and national connections? Are there other approaches we should consider?
- How might joint recruitment between Departments/Centers be used to increase our success in these areas?

MUST-DO TASK 1

Create an Awards Committee that collaborates with department chairs and other Vanderbilt leaders to identify, mentor and promote Vanderbilt faculty for appropriate honors, awards and distinctions.

When compared to other metrics of the success of our Research Enterprise (i.e., NIH funding), too few Vanderbilt faculty members receive the highest academic honors, such as membership in the National Academy of Sciences and/or Howard Hughes Medical Institute. There are two ways to remedy this situation: we can either improve our efforts to develop our own faculty into NAS and HHMI investigators, or we can recruit current members of those two organizations.

In order to improve our capacity to develop NAS and HHMI members from among our existing faculty, we propose to create a committee that will identify, cultivate, mentor and promote individuals in all departments for positions on national committees, review panels and advisory boards and for other honors in their own disciplines. This will serve as a means for developing faculty members for later recognition, including the higher honors of NAS or HHMI membership.

Our effort will be best served if we recruit an Awards Committee chairman who: 1) understands the landscape of the Vanderbilt research enterprise, 2) has knowledge of our faculty and their research interests, and 3) comprehends the process by which NAS and HHMI membership is successfully achieved and has links to these national organizations or their leaders. This position should require at least 50% effort and should be compensated at the institutional level. An appropriate title should accompany the position (i.e., Assistant Dean for Faculty Development).

The task force also discussed the recruitment of existing NAS and HHMI members. Recognizing the considerable cost of this endeavor, we recommend that the research enterprise carefully examine this strategy, and we endorse an investment in identifying and cultivating potential recruits from among NAS and HHMI investigator pools.

MUST-DO TASK 2

Create a process for sponsoring national and international symposia at Vanderbilt.

There was a general feeling among task force members that the achievements of our research enterprise are not widely recognized outside of the Vanderbilt community. Visitors to our campus often comment that they were unaware of how much outstanding research is being conducted here. Our Discovery Lecture Series has brought national leaders to our campus and this has likely helped to advance our reputation. Clearly, however, we can improve our efforts to promote the strengths of the Vanderbilt research enterprise. Our goal is to bring the top investigators in various fields to Vanderbilt to see our research infrastructure and learn of our faculty accomplishments.

We recommend that Vanderbilt sponsor an ongoing series of symposia on campus. These symposia should focus on important and compelling biomedical research themes. The themes should be chosen by campus leadership and should rotate among the various disciplines. Departments and Centers should host these symposia on a rotating basis, as determined by the theme and other criteria. Hosts should aim to invite the very top scientists in the field. Vanderbilt should underwrite the initial costs (securing hotel block, travel costs for keynote speakers, etc.), with the understanding that the hosts will attempt to defray these costs through federal and industry solicitations. At least two symposia should be sponsored per year, one in the spring and one in the fall.

MUST-DO TASK 3

Develop a comprehensive and appropriately targeted strategy to promote national awareness of the achievements of the Vanderbilt research enterprise.

The task force believes that the Vanderbilt research enterprise is under-valued by its peers. In order to address this, we recommend the development of a comprehensive plan to promote our achievements. It is critical that this plan be appropriately customized for different target populations, including foundations, philanthropic individuals, grateful patients and, not least, our peers in biomedical research. The goal of this effort is to raise national awareness of the great research being conducted at Vanderbilt.

The task force recognizes that Vanderbilt research enterprise self-promotion is not endorsed by all factions of the Vanderbilt faculty and urges the Office of Medical Center Communications to consider this when developing promotional material.

Appendix IV — 2008 Basic Science Planning Committees

Enhancing Communication Committee

Mac Buchowski (co-chair)	Gastroenterology
Roger Colbran (co-chair)	Molecular Physiology & Biophysics
Lillian Nanney (co-chair)	Plastic Surgery
Vivien Casagrande	Cell & Developmental Biology
Lou De Felice	Pharmacology
Frank Harrell	Biostatistics
Alyssa Hasty	Molecular Physiology & Biophysics
Debbie Murdock	Center for Human Genetics
Michelle Salisbury	School of Nursing
Greg Stanwood	Pharmacology

Sharing Research Information Committee

Dave Piston (co-chair)	Molecular Physiology & Biophysics
Melanie Lutenbacher (co-chair)	School of Nursing
Randy Blakely	Pharmacology
John Gore	Vanderbilt University Institute of Imaging Science
Rick Haselton	Biomedical Engineering
Shawn Levy	Biomedical Informatics
Dan Liebler	Biochemistry
Herb Meltzer	Psychiatry
Vicky Morgan	Radiology

Measuring Progress Committee

Mark Boothby (co-chair)	Microbiology & Immunology
Chuck Sanders (co-chair)	Biochemistry
Nancy Brown	Clinical Pharmacology
Alan Cherrington	Molecular Physiology & Biophysics
Tony Forster	Pharmacology
Michael Freeman	Radiation Oncology
Kathy Gould	Cell & Developmental Biology
Vsevolod Gurevich	Pharmacology
Karoly Mirnics	Psychiatry
Anita Mahadevan-Jansen	Biomedical Engineering
Roy Zent	Nephrology

Remaining Competitive in Research Committee

Marshall Summar (co-chair)	Pediatric Genetics
Hassane Mchaourab (co-chair)	Molecular Physiology & Biophysics
Pran Datta	Surgical Oncology
SK Dey	Pediatrics/Reproductive Biology
Wael El-Rifai	Surgical Research
Candice Fike	Neonatology
Todd Giorgio	Biomedical Engineering
Guoqiang Gu	Cell & Developmental Biology
Dennis Hallahan	Radiation Oncology
Christine Konradi	Psychiatry

John Morris	Trauma & Surgical Critical Care
Richard O'Brien	Molecular Physiology & Biophysics
John Phillips	Pediatrics/Medical Genetics
Prasad Shastri	Biomedical Engineering
James Sligh	Dermatology
Paul Sternberg	Ophthalmology
Mike Stone	Chemistry
John Wikswo	Physics

Graduate & Post-doctoral Education Committee

Bob Galloway (co-chair)	Biomedical Engineering
Joey Barnett (co-chair)	Pharmacology
Daniela Drummond-Barbosa	Cell & Developmental Biology
Aaron Bowman	Neurology/Movement Disorders
Chin Chiang	Cell & Developmental Biology
Ed Conture	Hearing & Speech Sciences
Ron Emeson	Pharmacology
Cynthia Gadd	Biomedical Informatics
Michael Holinstat	Pharmacology
Duco Jansen	Biomedical Engineering
Owen McGuinness	Molecular Physiology & Biophysics
Thomas Palmeri	Psychology
James Patton	Biological Sciences
Elaine Sanders-Bush	Pharmacology
Tony Weil	Molecular Physiology & Biophysics

Enhancing the Reputation of Vanderbilt Research Committee

John Penn (co-chair)	Ophthalmology
Mary Zutter (co-chair)	Pathology
Jim Crowe	Pediatrics Infectious Disease
Fred Guengerich	Biochemistry
Eva Marie Harth	Chemistry
Billy Hudson	Nephrology
David Johnson	Hematology/Oncology
Peter Martin	Psychiatry
Lynn Matrisian	Cancer Biology
Jason Morrow	Clinical Pharmacology
Michael Miga	Biomedical Engineering
Tao Zhong	Cardiology