



research and
development at
eastern virginia
medical school

Research And Development At Eastern Virginia Medical School

Eastern Virginia Medical School (EVMS), founded in 1973, is distinctive among medical schools in the United States. In the usual model, a medical school is attached to a university and/or owns a teaching hospital. Neither is true in the case of EVMS, which nonetheless has built very strong community attachments within Hampton Roads. It was founded by a diverse group of regional leaders who perceived the need for a medical school and is governed by a 17-member Board of Visitors, which includes 11 members appointed by seven of the region's cities. One of the hallmarks of EVMS is the cooperative relationships it has developed with regional hospitals and clinics as well as with many doctors.

An independent institution, EVMS is funded by a variety of sources. It does receive some funding from each city, though these dollars accounted for only 1.1 percent of its budget in 2001. It receives a greater share of funds (10.7 percent) from the Commonwealth, in recognition of the number of medical doctors EVMS trains that stay and practice in Virginia.¹ But EVMS is not a public entity in the usual sense of an Old Dominion University or a Jefferson Laboratory.

Prosperous medical schools have a tremendous economic impact upon their regions. An important aspect of this impact is research and development (R&D) activity, which generates an impressive number of attractive, high-paying jobs. An illustration is Johns Hopkins University, which spent almost \$1 billion on R&D in 2001, most of which was medically and life sciences-related ("Academic Research and Development Expenditures," National Science Foundation, 2003).

Because EVMS is a young institution that still faces daunting budgetary challenges, its research and development numbers are not yet in the Johns Hopkins class. EVMS recorded \$26.25 million in R&D expenditures in 2001 (183rd nationally), while neighboring College of William and Mary accounted for \$35.82 million (158th) and Old Dominion University, \$24.66 million (186th). Together, the three institutions would have finished 114th nationally. (All data come from the National Science Foundation.) Clearly, the region currently is not an R&D hotbed, though over time it could improve its performance dramatically. This chapter focuses on research and development at EVMS and the ways and means by which it and the region might improve their performances in this critical area.

The Major R&D Thrusts At EVMS

EVMS, like most higher education institutions, directs the majority of its R&D expenditures toward basic and clinical research. Its most extensive and successful projects can be divided into four broad areas: Cancer, Reproduction, Systemic Diseases and Infectious Diseases (see Graph 1).

¹ Interestingly, this is a slightly higher proportion of state support than the University of Virginia will receive as a proportion of its FY 2004 budget! The convergence between independent and public institutions of higher education is occurring more rapidly than many are aware.

**GRAPH I
MAJOR EVMS RESEARCH AREAS**

EVMS AREAS OF RESEARCH STRENGTH

Basic, Translational and Clinical

Cancer

Prostate
Breast
Leukemia
Head & Neck
Lung

Reproduction

**Jones
Institute**

CONRAD

**Systemic
Diseases**

**Strelitz
Diabetes
Institute**

Thomas Lee
Center for
Ocular Pharm.

**Infectious
Diseases**

Center for
Pediatric
Research

New Areas:

- Epidemiology
- Clinical Outcomes

**Sleep
Disorders
Center**

Glennan Center
for Geriatrics

Perhaps the best-known center at EVMS is the Jones Institute for Reproductive Medicine. Established 20 years ago, the center was the nation's first in vitro fertilization site and is unduplicated in Virginia. It has generated six patents that range from oral contraceptives to new 4-D fetal ultrasound diagnostic software.

The Jones Institute is also responsible for the first EVMS intellectual property to be marketed, "Seasonale," a three-month oral contraceptive that reduces women's menstruation cycles from 13 to four annually. It has been licensed to Barr Laboratories and is expected to earn FDA approval by the end of 2003.

Another well-known institution at EVMS is the Leonard R. Strelitz Diabetes Institute, which annually sees about 10,000 patients. The institute strives to discover a cure not only for diabetes, but also for problems such as diabetic neuropathy. The Diabetes Institute has discovered a gene named INGAP (Islet Neogenesis Associated Protein), which is responsible for regenerating the beta-islet cells that make insulin and other important hormones in the pancreas. This peptide has been licensed to GMP Companies Inc., which, in collaboration with Procter & Gamble Co., will produce a drug that may reverse diabetes.

The Center for Pediatric Research is working with electrical engineers at Old Dominion, Harvard University and the University of Washington to determine the effects of very short radio frequencies on human cells. Grants from the Air Force Office of Scientific Research and the Health Services Research Administration have facilitated the construction of a new Center for Bioelectrics. Researchers are optimistic that these pulse electromagnetic fields may provide a way to fight and kill cancer cells from "the inside out"; speed the healing of wounds (especially for soldiers and civilians injured in battle); treat contaminated water sources, and kill bacteria and spores to sterilize hospital and daycare equipment. The patented technology is the basis for a company that may generate attractive biotechnology jobs for the region. As Dr. Stephen Beebe, co-director of the project at the Center for Pediatric Research, has observed, "When you combine a physicist or engineer with a molecular biologist, the possibilities are endless."

The fourth major example of EVMS "hotbed" technology concerns the prostate cancer research conducted by the EVMS Department of Microbiology and Molecular Cell Biology. **EVMS researchers have initiated a method of "proteomic profiling" to develop early detection for prostate cancer, a disease that affects 4,300 Virginia men and kills almost 1,000 each year.** Working with the Virginia Prostate Center and the National Cancer Institute, researchers are optimistic that applications relating to breast and prostate detection, diagnosis and prognosis will be identified. The technology has resulted in 10 patents, nine pending patents, and 13 licensing and contractual agreements. This science potentially might allow doctors to screen for still other types of cancer, such as ovarian, bladder, neck and even leukemia.

Although these four examples are representative of EVMS's areas of expertise, it is important to note that EVMS research is more diverse. Two other interesting examples include the development of drugs to treat hyphema (bleeding into the front of the eye) and a partnership with Old Dominion University's Center for Medical Modeling and Simulation for research in virtual medical and surgical training.

Research And Development Spending Patterns At EVMS

Because Eastern Virginia Medical School is a much younger and smaller institution than other Virginia universities and colleges, it is no surprise that EVMS does not lead the state in research and development expenditures. As Table 1 indicates, EVMS trails the “Big Three” (University of Virginia, Virginia Commonwealth University and Virginia Tech) substantially in R&D expenditures. However, only Virginia Tech, at 49th, finished in the Top 50 in the United States in 2001. After EVMS, the next two top-ranking independent institutions in Virginia were Hampton University (251st) and the University of Richmond (416th).

Graph 2 illustrates the upward trends in various types of R&D funding at EVMS since 1975. While the U.S. government is the largest sponsor of EVMS research, private and foundation sources are almost as important.

Table 2 shows that support from the U.S. government is vitally important to research and development. The National Institutes of Health (NIH) is a particularly big player.

**TABLE 1
RESEARCH AND DEVELOPMENT RANKINGS:
TOP 200 INSTITUTIONS IN VIRGINIA**

Institution	Annual Expenditures	National Ranking
Virginia Tech	\$216.3 m.	49th
UVa	\$149.5 m.	78th
VCU	\$ 99.2 m.	104th
William and Mary	\$ 35.8 m.	158th
EVMS	\$ 26.3 m.	183rd
Old Dominion	\$ 24.7 m.	186th

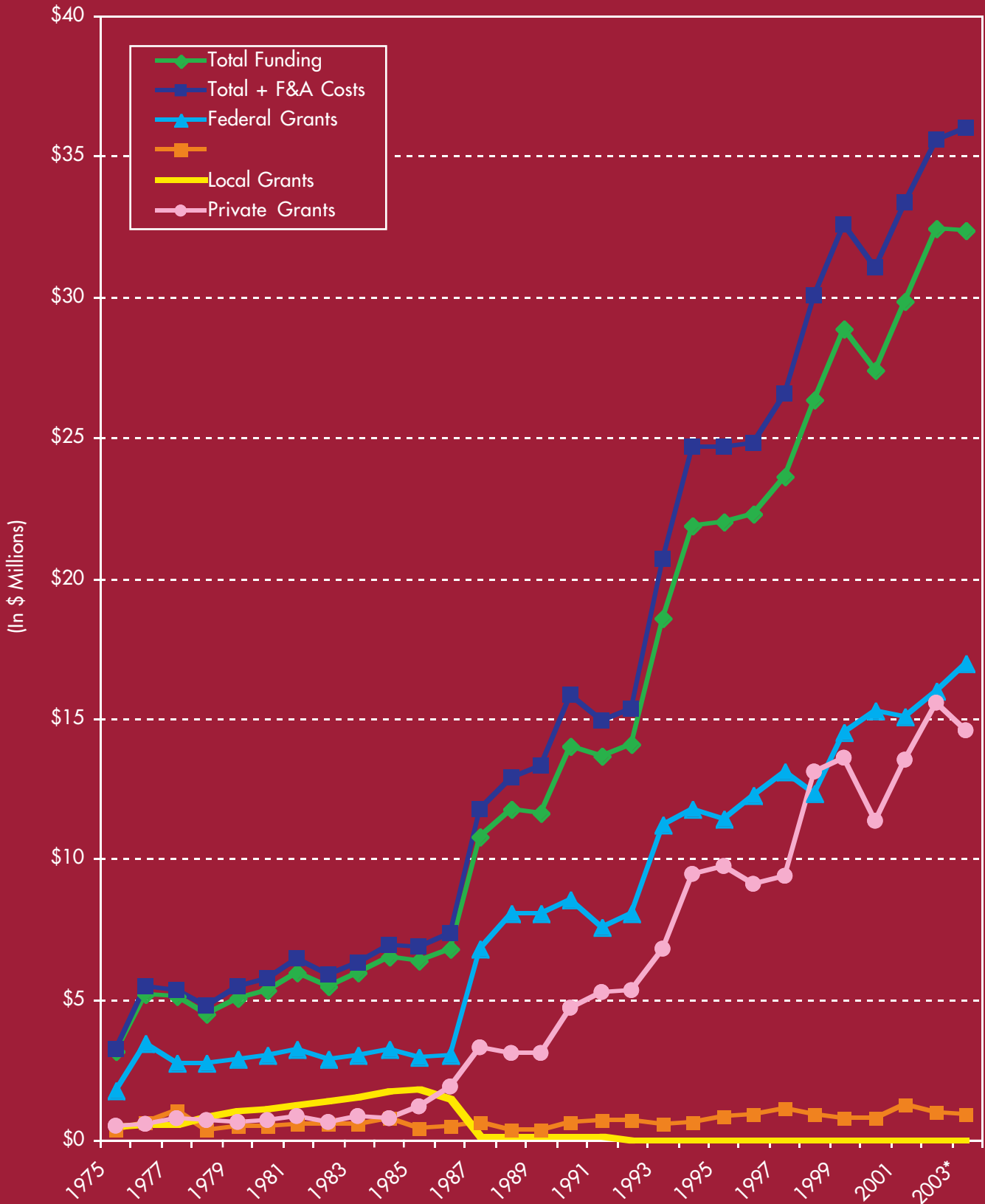
Source: “Academic Research and Development Expenditures: Fiscal 2001,”
National Science Foundation, 2003

**TABLE 2
PERCENT OF RESEARCH FUNDING RECEIVED
FROM THE U.S. GOVERNMENT**

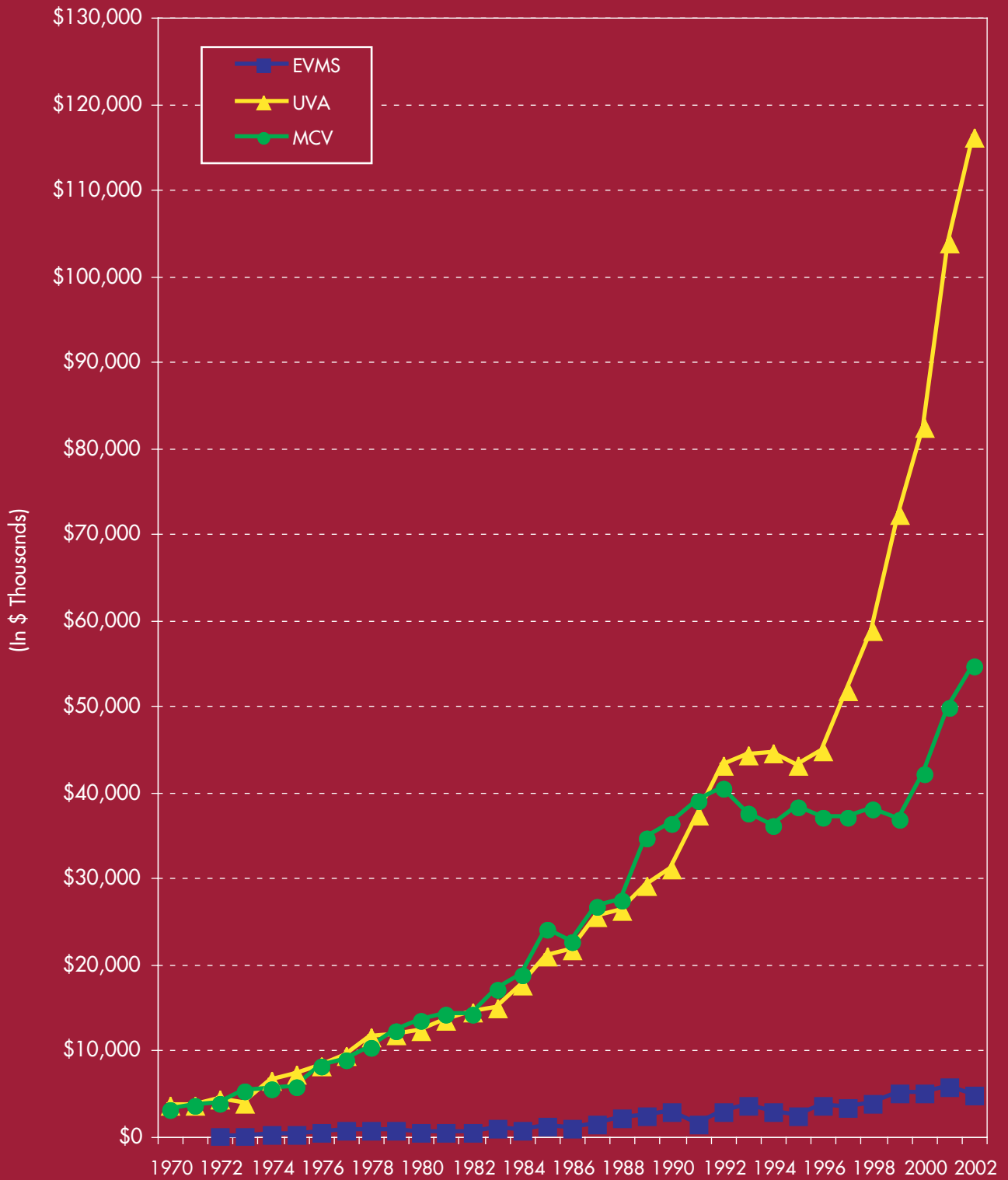
Institution	Percent of R&D Funds Received from U.S. Government
UVa	66%
VCU	60%
EVMS	56%
Virginia Tech	40%

Source: State Council of Higher Education for Virginia, “2002
Condition of Research at Virginia Colleges and Universities”

**GRAPH 2
GROWTH IN EVMS RESEARCH FUNDING**



**GRAPH 3
NIH FUNDING AT THREE VIRGINIA INSTITUTIONS**



The three Virginia medical schools (UVa, VCU, EVMS) and Virginia Tech dominate NIH funding, which is the staple of medical and biotechnology research. Graph 3 demonstrates that EVMS's funding from NIH has grown over the past two decades, but is dwarfed by NIH funding granted to the two other medical schools. UVa's funding from NIH, for example, is about 20 times larger than that at EVMS. However, EVMS's rate of success for its NIH proposals has exceeded 20 percent in recent years, a commendable achievement in light of the 8.6 percent approval rate nationally.

When EVMS is compared to all medical schools in the country, it clearly ranks in the bottom one-half in terms of R&D funding. However, as the data in Table 3 illustrate, when EVMS is compared to a cohort of 16 similar, small, community-based medical schools established within the past 40 years, its ranking improves substantially. And, in terms of NIH funding, EVMS ranked sixth among this cohort in 2001.

Since its founding, EVMS has received 42 patents. It currently has 31 patents pending with pending licensing fee income of \$30 million. The institution also has 10 licensed technologies that have led to the formation of three companies, with another two pending.

A general rule of thumb is that an institution should have at least one scientific disclosure for every \$1 million to \$2 million in research income generated each year. EVMS has recorded an average of two disclosures per year, or one per \$1.5 million of research. As

Table 4 reveals, during FY 2001, EVMS recorded 15 disclosures and filed 22 patent applications. Locally, Old Dominion University recorded 22 disclosures and filed eight patent applications, while William and Mary recorded eight disclosures and filed one patent application. Together, the three institutions recorded 45 disclosures and filed 31 patent applications, which is encouraging. Even so, this level of activity is only a fraction of that occurring at UVa, VCU and Virginia Tech. Their activity, in turn, is only a fraction of what one observes in a particular neighboring state, North Carolina.

**TABLE 3
NATIONAL BENCHMARK MEASURES FOR MEDICAL SCHOOLS**

Institution	Total Expenses and Transfers, FY 2001	Research Grants and Contracts, FY 2001
EVMS	\$148.1 m.	\$21.4 m.
National Average for All Medical Schools	\$363.1 m.	\$74.4 m.
Average for Community-based Medical Schools	\$ 94.8 m.	\$ 8.5 m.
EVMS National Rank	100th	86th
EVMS Community-based Rank	2nd	1st

Source: Eastern Virginia Medical School, "Report on Performance Trends," January 2003

Note: The community-based medical school group includes: Texas A&M, East Carolina, Southern Illinois, Mercer, Wright State, Northeastern Ohio, East Tennessee, Nevada, South Carolina, Morehouse, Michigan State, Marshall, Hawaii, South Dakota, North Dakota and EVMS.

TABLE 4
TECHNOLOGY TRANSFER ACTIVITY IN VIRGINIA FY 2002

Institution	Number of Disclosures Recorded	Number of U.S. Patent Applications	Number of U.S. Patents Received	Number of Licenses Signed	Number of Start-up Companies
EVMS	15	22	3	7	0
GMU	24	10	1	1	0
ODU	22	8	5	5	2
UVA	135	186	17	37	1
VCU	93	69	11	15	0
VA TECH	134	91	23	28	7
W&M	8	1	1	0	0
Total (VA)	434	387	61	93	0
Total (U.S. and Canada)	13,569	6,812	3,721	4,058	494

Sources: Virginia's Center for Innovative Technology, 2003, and the Association of University Technology Managers' "Licensing Survey, FY 2001"

Regional And State Policy Considerations

By most standards, then, our region is not a big-time national player in terms of R&D expenditures that occur outside of federal laboratories. When the R&D efforts of all of the region's institutions of higher education are combined, they approximate \$100 million annually, which would rank the region 102nd nationally if it were generated by a single institution. Compare this to the approximate \$750 million in R&D generated by the three universities (Duke University, North Carolina State University and the University of North Carolina) in the Research Triangle of North Carolina.

Nor does the entire Commonwealth of Virginia stack up well. In 1999, southeastern competitor states such as Florida, Georgia, Maryland and North Carolina all outperformed Virginia in terms of university R&D, and they did so by significant margins. According to the State Council of Higher Education for Virginia's "2002 Condition of Research at Virginia Colleges & Universities Report," Virginia ranked only 16th in the nation in terms of its academic R&D spending. Virginia accounted for only 2 percent of all academic R&D expenditures in 2002. On a per capita basis, Virginia ranks only 37th.

Gov. Mark Warner has set a bold goal for the state – to nudge three of its academic institutions into the ranks of the nation's top 50 research universities by 2010. Given current levels of higher education funding in the Commonwealth, this is a pipe dream. Of course, the Commonwealth could increase its higher education and R&D investments. However, just to bring the funding of Virginia's public colleges and universities to the average levels of their peer institutions would cost about \$300 million annually. Even then, it's not clear that "average" funding levels would be sufficient to match the performance of other states such as North Carolina. Further, as the North Carolina and Texas experiences demonstrate, the payoff to such investments would not be immediate, though the rates of return would be impressively high. Those who expect investments in higher education and research and development to generate immediate economic growth benefits are likely to be disappointed.

Alternatively, the Commonwealth could focus its efforts on R&D areas where it might capitalize on existing strengths. The existing scientific and technological strengths of Virginia include federal R&D laboratories located in the Commonwealth (for example, NASA Langley Research Center, the Jefferson Laboratory, and the Joint Training, Analysis and Simulation Center). These laboratories engage in extensive, high-level R&D, though usually it is not directed at commercialization. In addition, the Commonwealth boasts impressive information technology assets, primarily in Northern Virginia, the presence of the federal government and the defense establishment in Washington, D.C., and Hampton Roads, and promising pockets of R&D

activity at several of its universities and medical schools. Capitalizing on these strengths makes eminently good sense. It seems plausible that a winning long-term strategy for Virginia would be centered on its existing assets and strengths.

The economic theory of comparative advantages applies not only to nations, but also to states and regions. There are fundamental economic reasons why Virginia does not grow its own bananas, but has become a center for Internet traffic and services. States and regions that ignore their comparative advantages suffer because they end up supporting high-cost scientific enterprises. Hence, it would be foolish for the Commonwealth to ignore the reality of its federal laboratories and the Northern Virginia information technology complex as it develops its own strategy. Not so coincidentally, such an approach would favor Hampton Roads, which boasts many of the federal installations upon which a critical mass of R&D activities might be constructed.

Third, Virginia could look into the future, identify the scientific specialties and technologies that it believes will be most important in the future, and then invest in them. Both the Commonwealth of Virginia and the Hampton Roads Partnership already have undertaken this exercise (see Table 5). Unfortunately, neither has backed its deliberations with anything more than minimal resources. Regardless, such a “pick the winners” approach requires a degree of skill (or luck) in prognostication that experience suggests most governments do not have. The failure of meticulously planned “industrial policies” internationally, most visibly in the Soviet Union and Eastern Europe, but also in Japan, should make Virginians very wary of attempts to supercede either legitimate scientific processes or the signals provided by capital markets.

TABLE 5
UNIVERSITY AND MEDICAL SCHOOL COMPETENCE IN PRIORITY RESEARCH AREAS

Statewide Priority Areas

Bioinformatics	VCU, VT, GMU, UVA, W&M
Information Security	JMU, GMU, HU, UVA
Nanotechnology	UVA, VCU, W&M, VT
Modeling and Simulation	ODU, GMU, UVA, HU, W&M
Advanced Materials	UVA, VCU, VT, JMU, ODU, NSU, W&M, VSU

Hampton Roads Priority Areas

Bioinformatics and Data Management	W&M, ODU
Marine Biology and Biotechnology	W&M, ODU, Jeff Lab, NASA
Proteomics	EVMS (with ODU, W&M)
Biomedical Instrumentation and Imaging	Jeff Lab (with W&M, HU, EVMS)
Atmospheric Biology and Sensors	NASA, HU
Bioelectrics	ODU (with EVMS)
Cells, Cancer and Infectious Disease	EVMS, ODU
Nanotechnology	NASA, Jeff Lab (with ODU, W&M, HU)

Sources: Statewide Priorities from “VRTAC Briefing to Virginia’s Congressional Delegation, 2002,” and SCHEV. Hampton Roads Priorities from Virginia Biotech Meeting in Hampton Roads, Oct. 7, 2002.

One can “blue sky” almost endlessly about R&D in Virginia and scores of interesting conferences can be held. However, it must be recognized up front that the major problem associated with R&D in Virginia is under-investment. **The Commonwealth has attempted to reap major-league scientific and economic benefits from minor-league levels of investment. The discouraging national R&D rankings reported previously are visible evidence of the fruits of this approach.**

But, if under-investment is generally true in Virginia as a whole, it is dramatically apparent within Hampton Roads. The region’s medical school, EVMS, is small in a national context and has faced continual funding challenges. It does not receive large amounts of public funding, faces critical shortages of R&D space, does not have a formal affiliation with a university, and experiences high unit costs for many of the administrative and support services it provides to its researchers. While it has

done rather well in light of these limiting circumstances, EVMS will not realize its potential unless these circumstances are changed. A plausible agenda for improvement would include:

- Increasing EVMS's funding from the Commonwealth (In FY 2002, EVMS received \$13.2 million; a reasonable goal for Virginia should be to double this by 2010.)
- Increasing the size of the medical school so that it might realize some economies of scale (UVa and Virginia Tech have seven to 10 times the number of investigative faculty as EVMS.)
- Having the Commonwealth subsidize or pay for the construction of R&D facilities at EVMS (This might be most plausible in partnership with regional state universities; EVMS has only 35 percent of the square feet it should for the size of its R&D establishment, according to SCHEV, Virginia's higher education commission.)
- Focusing R&D efforts at EVMS on selected disciplines and problems where promise is great, economies of scale are possible and partnerships with other institutions are feasible
- Negotiating a limited university affiliation (Old Dominion University is the obvious candidate) to promote greater sharing of services and to achieve lower administrative and operational costs
- Developing additional cooperative efforts with other institutions throughout the region (EVMS's small size often means that it has difficulty achieving a critical mass of researchers in specific research areas, and joint R&D proposals to the Commonwealth and U.S. government agencies often are attractive.)
- Including EVMS in statewide scientific initiatives such as the legislature-appointed Joint Commission on Technology and Science and the Virginia Bioinformatics Consortium, which currently do not invite EVMS to their conferences and meetings (The SCHEV 2002 report on the "Condition of Research at Virginia Colleges and Universities" failed to mention or include EVMS in any of its analysis and rankings; these oversights need to be reversed.)
- Developing more research-friendly local and regional governmental attitudes (Numerous studies reveal that an entrepreneurial atmosphere is critical to productive R&D.)

To some extent, the progress of research and development at EVMS depends upon the prosperity of the region's two public universities that generate credible amounts of research. Their presence and cooperative activities are vital if the region is to achieve critical mass in specific scientific disciplines. Like EVMS, Old Dominion University and the College of William and Mary are substantially under-funded relative to their national peer institutions, according to several recent legislative studies. Therefore, it should not come as a surprise that neither is a major R&D player in an overall national sense, though both have developed selected areas of expertise that might be enhanced. More is the pity. **Numerous studies (most recently, by the Milken Institute, 1999) found that areas characterized by rapid economic growth have one thing in common – the presence of at least one nationally prominent research university. Hampton Roads may never have that single dominating university entity, but it can approximate those effects by investing in institutions that already have established R&D legitimacy.**

The truth with respect to regional research and development is inescapable and brutal. Over time, the region's legislative delegations did not place a high priority upon either higher education funding in general or R&D funding in particular. Most legislators have never understood or perceived the long-term regional benefits associated with R&D activities. Hence, EVMS, Old Dominion and William and Mary never were accorded the legislative priority that metropolitan institutions such as George Mason University and Virginia Commonwealth University received from their legislative delegations. All too often, where regional R&D support is concerned, some Hampton Roads legislators have attempted to reap where they have not sown. Many have been more interested in tax cuts (read "service cuts") and small pieces of local pork than in long-term investments in the region's future. Perhaps we should not blame these legislators, given the apparent tenor of the electorate. Nonetheless, in 2003, the impact of these misplaced priorities is abundantly clear, and the malaise of the region in the R&D arena cannot easily be cured. **Just as the Commonwealth's faulty approach to banking legislation and mergers proved within a decade to be very costly, so also its approach to the support of R&D over the past decade is now revealed to have had disastrous effects.**

EVMS's promising, though inadequately funded, R&D efforts are a prime example in this regard. Using as a base the 1997 Economic Impact Study of EVMS conducted by Old Dominion University, we estimate the current annual economic impact of the medical school to approximate \$630 million. **The medical school's involvement in R&D is directly and indirectly responsible for \$71 million of that economic impact and 1,051 jobs in the region. This is an impressive contribution and one that begs for expansion.** That goal – expanding research and development at EVMS – should be adopted now both by regional leadership entities and by the Hampton Roads legislative delegation.

