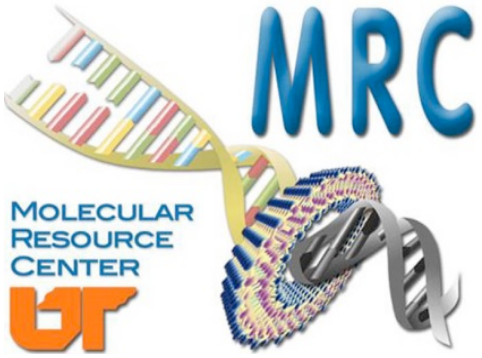

Molecular Resource Center of Excellence
2022–2023 Annual Report to the Tennessee Higher Education Commission

October 27, 2023

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I. Executive Summary

The Molecular Resource Center (MRC) of Excellence is an essential and successful institutional core research service that was established in 1985. Dedicated to providing state-of-the-art molecular technologies, fostering collaborative and interdisciplinary research, and providing education relevant to advancing molecular technologies, the MRC supports the research mission and prominence of the State of Tennessee. The successful accomplishment of this mission has been a result of continuous funding from the Tennessee Higher Education Commission (THEC) for a significant portion of the MRC operations and continuous matching funds support from the University of Tennessee Health Science Center (UTHSC). MRC's services are essential for our investigators to maintain their research programs during continuing constraints in federal funding levels. Over the past five fiscal periods, we provided high quality DNA sequencing, whole genome, or next-generation sequencing (NGS), microarray-based gene expression analysis and nucleic acid amplification by polymerase chain reaction (PCR) services to our customers.

In FY23, the MRC generated less total recovery ($137,326) than in either FY22 ($204,424) or FY21 ($167,408). Extramural grant and contract awards on the UTHSC campus slightly decreased in FY23 relative to a peak of $133,973,000 in FY22, a $7.27 million increase over FY21's value of $126,700,000. As has been observed since the FY18 period, the majority of researchers we serve for whole-genome, next-generation sequencing (NGS) projects selected commercial vendors instead of the MRC for their projects. These decisions have been primarily driven by cost sensitivity as there is reduced per sample pricing widely available

commercially in a highly competitive global market. Commercial vendors operate high-throughput sequencers as opposed to the mid-throughput instruments housed in the MRC. Commercial vendors continue to compete for academic business by offering “new customer” bulk order discount pricing to researchers, in addition to their lower overall per sample prices. The type of MRC customers who have decided to send their NGS samples to commercial vendors do not typically need extensive experimental design consultation, or local expert advice on how to troubleshoot sample preparation, or assistance with downstream raw data analysis (they analyze their own data). In FY19-FY23, those customers with small to moderate sample sizes who rely on the MRC for the above expertise and services continued to use the MRC to support their research program. In FY22, recoveries from NGS services had decreased to $19,505 and only 15 total sample libraries were prepared for NGS services, for 7 “runs” for the entire FY. In FY23, recoveries from NGS services increased to $26,615, primarily due to the increase in sample library preps to 120 libraries, sequenced over 5 “runs”.

To entice UTHSC researchers to return to the MRC for their sequencing needs, in Q3 of FY23, we negotiated with our regional Illumina manager to obtain a larger percentage discount on NGS library prep reagents and sequencing cartridges. Revised, discounted pricing, which was widely advertised, led to several customers to submit larger-scale projects during Q4. Since NGS projects are billed at completion, which occurred after FY24 began, the revenues from these projects will be accounted for in the FY24 annual report. We have continued to advertise the Illumina limited-time, “special pricing” in weekly email blasts, and at the Office of Research Resource Fair held in September of 2023 and we continue to offer discounted pricing to customers during consultations. We anticipate this

agreement with Illumina, expected to be offered through June of 2024, will lead to more active use of NGS services in the MRC throughout FY24 since our in-house pricing is now very similar to commercial vendor service pricing.

To address researchers' price sensitivity while seeking to improve customer support for their research projects, we decided in FY22 to invest in a new NextSeq2000 instrument. The Illumina NextSeq500 instrument was traded-in and its residual value was applied to the purchase of a new, heavily discounted, Illumina NextSeq2000 instrument. Payment for this instrument was structured to be split between FY22 and FY23, with the expectation that increased revenues realized in FY23 would at least partially offset the costs of the new system. The instrument arrived to UTHSC in June of 2022 and the first run was performed in July of 2022 (Q1 of FY23). Acquisition of the NextSeq2000 instrument has not only reduced the per the sample pricing for the NGS library preparation kits and the Ilumina flow cells relative to the NextSeq500, but also facilitates quicker turnaround time for our customers due to its expanded sequencing capacity. The largest flow cell for the NextSeq2000 produces 1.2 billion of paired-end reads, which approximates the output from the 'small scale' flow cell on the NovaSeq platform. Widespread communications highlighting NextSeq2000 services and the reduced NGS per sample pricing began in Q3 of FY23. In addition, Illumina provided an on-campus seminar to our community on October 27, 2022.

We also considered the needs of investigators who process very high sample volumes, which is more appropriate for sequencing on a NovaSeq, high-throughput instrument. UTK acquired a NovaSeq6000 system in May of 2022. After learning of this news, we established a relationship with UTK to facilitate

UTHSC investigators to use the UT Genomics Core at Knoxville core at internal pricing. A webinar highlighting UTK's NGS services in the was provided to the UTHSC Memphis community by Veronica Brown on May 23, 2022.

Overall, during FY22-FY23, options for "in-house" NGS services were expanded and service fees were reduced based on instrumentation scaling, allowing us to be more price competitive with commercial vendors. We expect these developments will translate into higher recoveries for the MRC throughout FY24 and going forward.

In FY22, the demand for Agilent Affymetrix services sharply decreased from 185 processed samples in FY21 to 45 processed samples in FY22, which decreased to no processed arrays in FY23. Since researchers no longer choose arrays over NGS, since pricing is near-equivalent, we made the decision to sunset microarray services in February of 2024, when the current Affymetrix service agreement for the array equipment expires. Customers who would like to process microarray samples will be referred to the Yale microarray core. Another factor responsible for the drastic decrease in microarray volume is that the lead technical staff member who led the array services retired from UTHSC in January of 2022, Mr. Lorne Rose. His replacement, Ms. Zoe Brookover, was trained by Affymetrix to process microarrays in October of 2022, but the equipment failed during training and required prolonged servicing to become functional. In the interim, researchers had made the switch to NGS to analyze gene expression.

In Q4 of FY20, the Office of Research in conjunction with the MRC decided to sunset Sanger sequencing services during Q1 of FY21. Sanger sequencing has

been a commodity service, with services available from a wide variety of commercial vendors, for >20 years. The MRC did not accept samples for Sanger sequencing after September 15, 2021, and all submitted work was completed in-house by September 30, 2021. We instead maintain a contract with an external vendor (GeneWiz, now Azenta) to offer discounted Sanger sequencing services. Azenta usage increased from FY21 (1,058 samples) to FY22 (2,527 samples) and again in FY23 (3,315 samples). However, the volume of Sanger sequencing requests has plummeted since FY19 (9,272 samples) with the advent of gene synthesis on-demand services, and the increase in the number of vendors who offer off-the-shelf, pre-cloned, sequence-verified constructs.

The volume of QiaCube automated nucleic extraction samples decreased from 705 samples in FY22 to 477 samples processed in FY23. Likewise, the revenues for real-time PCR services and reagents for the Roche LC480 platform decreased in FY23 ($11,304) as compared to FY22 ($16,785). One reason for this decrease was that ~200 qPCR “runs”, equivalent to ~$2,400 in revenues, were not billed in the iLab core management system due to a clerical error that occurred in FY23 (a failure to mark the run as “complete”). This issue has been addressed for FY24.

Overall, FY23 ended with a net income of $25,116 to be carried forward to FY24 (Schedule 7); the primary driver of the carryover was the delay in paying for the invoice for the Mantis liquid handling system prior to the closeout of the FY. The invoice was paid in July of 2023 using FY24 funds. During FY23, the MRC provided 9,520 units of service on behalf of behalf of 65 total investigators (64 internal and 1 external users). The internal users represented 17 departments within four Colleges at UTHSC in Memphis, TN (College of Medicine, College of Pharmacy,

College of Dentistry and College of Health Professions). The single external user was located at the University of Memphis. In FY23, the MRC contributed to 151 peer-reviewed publications and review articles, and the MRC supported 71 extramural grants, subawards or contracts. The Director, Dr. Taylor, provided >75 consultations to core users and 10 letters of support to 10 PIs for a total of 10 grant applications. Dr. Taylor also trained 25 new core users in molecular technologies, primarily new students and postdocs. Twelve tours of the MRC were offered to prospective faculty and new employees.

There is growing interest in investing in spatial genomics instrumentation on the Memphis campus, which could be managed by the MRC, for example, via the GeoMX digital spatial profiler platform offered by Nanostring. During FY24, due to continued budget constraints, there will likely be insufficient local matching funds available, beyond those already allocated for personnel and supplies, to support any large equipment purchases for the MRC specifically, or for any of the UTHSC institutional core facilities in general. The MRC and Dr. Seagroves will continue to work closely with the Interim Vice Chancellor for Research, Dr. Wesley Byerly, to manage investments in emerging molecular technologies. A primary mission of the Executive Director, the Associate Vice Chancellor for Research—Core Laboratories, and the Office of Research senior administration going forward will also be to ensure that matching funds remain available from UTHSC to supplement the portion of the MRC operating budget provided by the THEC.

The MRC continues to enhance its services with tools and procedures to increase productivity, as well as increasing the user's understanding of MRC services, as key components in investigator-initiated research. The MRC's investment in state-

of-the-art analytical tools and procedures provides researchers with a competitive advantage for new and renewal grant applications, providing a clear return on investment (ROI). In order for all UTHSC campus investigators to take advantage of the THEC's investment in the MRC, we also support educational programs about current and emerging technologies through seminars and webinars.

In 2015, MRC expanded its services to include an "in-house" research bioinformatics core for molecular informatics (Molecular Bioinformatics, mBIO) that was initially formally housed under the MRC umbrella. The core is directed by Dr. Daniel Johnson, who was recruited to campus in May 2015. The mBIO core successfully addressed a prior unmet need on our campus, which is the analysis of large-scale data generated in the MRC from microarray and NGS-based profiling studies at a subsidized rate. The mBIO unit provides pre-experimental design consultation (at no charge) and post-experiment data analysis (at a subsidized hourly rate) to all UTHSC campus investigators, including statistical analysis support after raw data are generated by the MRC. Because the services of the mBIO core are not subsidized by THEC, its activities are not included in the annual reports. However, because the mBIO core resides in the same physical footprint as the MRC, this allows seamless generation and analysis of NGS and microarray data. The mBIO and MRC Core Directors and staff work closely together to assist investigators in execution of their research programs by jointly participating in all initial experimental design consultations, which are mandatory before samples are accepted for processing. When the mBIO core advertises its services through Spring and Fall intensive workshops, the demand for NGS and array services at the MRC increases concordantly.

II. Mission Statement

The mission of the Molecular Resource Center of Excellence (MRC) at The University of Tennessee Health Science Center is to extend and to enhance the molecular and cellular research capabilities of the research community by providing access to the latest technologies for exploring the molecular basis of health and disease. To provide these technologies, the MRC invests in equipment, and trained personnel and provides educational and workforce development experiences. In addition, because the MRC is allied to all basic science and clinical science research units throughout the state, a component of this mission is to serve as a nucleus for collaboration and interdisciplinary research within the State of Tennessee.

*Tools for Success***.** A fundamental objective of the MRC is to provide the research community with molecular tools that are essential for successful research. This is a dynamic process of assessment and anticipation to provide the intellectual and physical infrastructure that is responsive to the needs of the research community. With this objective in mind, the MRC developed an organization structure of a faculty-level Director, and core staff with a breadth of training in molecular biology, supported by a senior administrative support staff member. The MRC and its staff have invested significantly in tools and facilities to provide high throughput sequencing of nucleic acids, large-scale analyses of the genes expressed in healthy and diseased organisms, ranging from bacteria to human, analyses of the genome of organisms, computational tools to analyze complex data, and the use of unique models of human disease. This intellectual and physical infrastructure that has developed around the MRC allows researchers to be nimble in their

research and to move forward at a pace that sets a benchmark for competitiveness in biomedical research.

Moreover, the MRC is listed as an essential core facility and institutional resource for the majority of grant proposals submitted by our users, including investigators with multiple R01 or similar extramural awards, such as Dr. Jon Jaggar (Department of Physiology), Dr. Radhakrishna Rao (Department of Physiology) and Dr. Liza Makowski (Department of Medicine). Therefore, the MRC is an essential component of research infrastructure on the UTHSC campus. The MRC occasionally serves several external principal investigators through contracts negotiated with external universities located in the Memphis area (University of Memphis, Rhodes College and Christian Brothers University), the Mid-South region, across the United States and around the world.

Expert Staff. The focus of MRC activities is to stimulate the development and dissemination of new methodologies and procedures as they become available to the scientific community. To stay abreast of current and emerging technologies, the MRC staff actively participates in professional development activities. These include formal activities such as scientific or professional development meetings and seminars, which moved to virtual formats in 2020-2022, with the return to in person meetings in 2023. Other development activities are unstructured, such as reading journals and one-on-one or small group interaction with other scientific and technical personnel. In addition, the MRC staff devotes considerable time to developing novel protocols, optimizing and scaling established protocols to minimize reagent costs and refining downstream raw data analyses, and workflows.

The Associate Vice Chancellor for Research—Core Laboratories, Dr. Tiffany Seagroves, is also a user of MRC resources. She has been consistently extramurally funded as a cancer researcher since 2005. In addition to “wet bench” research and laboratory management skills, she brings additional management and operating expertise to the institutional core facilities through her M.B.A. training. Dr. Seagroves has attended the Association for Biomolecular Research Facilities (ABRF) annual national meeting since 2015 to remain informed about core management best practices and strategies, including application of federal fiscal policies related to core operations. In 2018, Dr. Seagroves was elected to the executive board of the ABRF’s regional chapter for core facilities, the Southeastern Association of Shared Resources (SEASR), and she served the final year of her five-year term on the board from June 2022 to June 2023. Dr. Seagroves recently completed service as the SEASR chapter President (June 2021 to June 2022). Dr. Seagroves currently serves on one sub-committee of the ABRF society, the finance audit committee. In May of 2023, Dr. Seagroves became PMP (Project Management Professional)-certified by the Project Management Institute, after passing the PMP certification exam with above target scores.

Dr. Seagroves previously served on both the UTHSC Vice Chancellor for Research, Research Cabinet (VCR Cabinet) and the Operational Strategic Plan for Research (OSPR) committees. The VCR Research Cabinet advised the VCR on all activities relevant to research and the OSPR committee was charged with developing and executing a 5-year plan to strengthen research on campus. A key component of the OSPR was planning for core facilities and other research infrastructure units, with the goal of aligning projected research needs and priorities with the health science center campuses core capabilities. The first

version of the OSPR was developed over FY16 and was published in September 2016 and was revised in 2021. Supporting core facilities on campus was again a major initiative highlighted in v2 of this strategic plan, with a “Cores” sub-committee devoted to analysis of research infrastructure needs that will best align with our research strengths and that will cross disciplines. As the largest molecular core facility on campus, the MRC is an integral stakeholder in executing the current and any future strategic plans for research. Dr. Steven Goodman stepped down from his role as Vice Chancellor for Research in January of 2023, and Dr. Wesley Byerly became the Interim VCR. A search for a new VCR launched in FY23, and is currently ongoing.

Education and Training. Another important part of the MRC mission is to provide educational opportunities. In an academic institution at the cutting edge of biomedical research, investigators must stay abreast of the technologies available; the MRC serves to focus this continuing education on molecular and cellular technologies. Fulfillment of the education mission has three goals: 1) develop a skilled workforce in the biomedical sciences, 2) keep investigators abreast of current and advancing technologies, and 3) allow investigators to discover new avenues to propel their research programs that ultimately shape the MRC’s investment in new technologies.

Workforce development is vital to the future of biomedical sciences research and industry in the State of Tennessee. For many of its functions, the MRC serves as a teaching laboratory for undergraduate and graduate students, technical staff, and investigators. The MRC staff instructs these users one-on-one at the benchtop and then provides guidance as new core users develop their skills. Because the MRC

continually monitors advancing technologies to anticipate needs of investigators, it is in the best position to provide educational programs to investigators about the use of current technologies and technologies that are on the horizon. Each year, the MRC hosts seminars and workshops on topics designed to enhance progress in the UTHSC community by raising awareness of new molecular tools that are available. The investigators served by the MRC are always looking for improved strategies to answer their scientific questions. In FY21-FY22, large group seminars were restricted due to the COVID-19 pandemic. However, we returned to in person seminars in FY23, including visits by vendors to advertise new technologies.

Assessing Needs and Satisfaction. Through frequent dialog with the investigators we serve, and meetings of the core internal advisory board (IAB), the MRC investigates specific investments in, or adaptation of, technologies to best meet investigator needs. Needs are also brought to the MRC's attention for consideration through individual principal investigators, the IAB and the Office of Research. Needs that cannot be currently met by MRC are referred to the Associate VCR or to the VCR for further consideration. Campus survey tools are in place to inquire about research needs on campus and to gauge the overall satisfaction with individual core services.

Collaboration. The MRC is an integrative unit that is egalitarian in its delivery of services across all units within the Tennessee research community. In this role, the MRC fosters collaboration between researchers, and the development of interdisciplinary research. For example, the MRC sponsors seminars and workshops in genomics, bioinformatics, microarray technologies and other molecular technologies. In addition, the MRC has participated in

seminars/webinars offered by the ABRF or SEASR. In collaboration with the UTHSC Center for Integrative and Translational Genomics (CITG), the MRC has underwritten and developed numerous collaborations that use state-of-the-art molecular technologies. Likewise, the MRC is playing a significant role in the development of large-scale collaborations to understand complex gene interactions through mouse models of human disease. These highly visible efforts have placed The University of Tennessee in a position whereby researchers may take fullest advantage of funding and research opportunities.

III. Center of Excellence Overview

a. **Center Name**: Molecular Resource Center of Excellence

b. **Center Location**:
   i. Administrative Address –
   University of Tennessee Health Science Center
   Translational Science Research Building (TSRB)
   71 S. Manassas St., Room 110
   Memphis, TN 38163

   Web address-
   https://www.uthsc.edu/research/institutional-cores/mrc/index.php

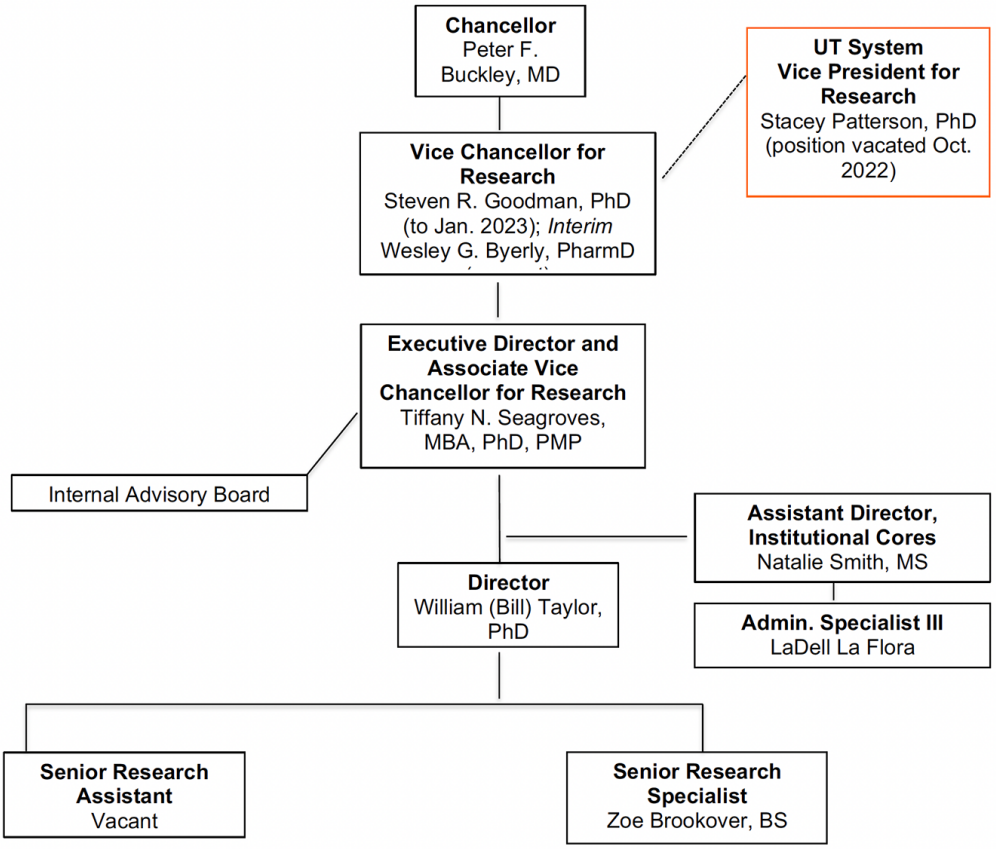
   ii. Laboratory Address –
   Molecular Resource Center
   Translational Science Research Building (TSRB)
   71 S. Manassas St., Room 110
   Memphis, TN 38163

c. **Name and Title of Person Responsible for Administering Center**:
   Tiffany N. Seagroves, M.B.A., Ph.D.
   Executive Director
   Associate Vice Chancellor for Research—Core Laboratories
   Professor of Pathology
   College of Medicine
   University of Tennessee Health Science Center

d. **Unit Which Houses Center**:
   Office of Research
   Vice Chancellor for Research
   University of Tennessee Health Science Center

   Steven R. Goodman, Ph.D.
   Vice Chancellor for Research (June 2022-January 2023)

   Wesley Byerly, Pharm.D.
   Interim Vice Chancellor for Research (January 2023-present)



FY23 Organizational Structure. The Molecular Resource Center (MRC) is located within the organizational structure of the University of Tennessee system under the Office of Research, which is directed by the Vice Chancellor for Research. The center itself is under the supervision of the Executive Director, Dr. Tiffany Seagroves, and the Core Director, Dr. Bill Taylor. Dr. Seagroves is a professor in the Department of Pathology in the College of Medicine. As Executive Director of the MRC, Dr. Seagroves reports directly to the Vice Chancellor for Research, currently Dr. Wesley Byerly (*Interim*). The VCR reports directly to the Chancellor of UTHSC, currently Peter F. Buckley.

The day-to-day operations of the Center in FY23 were supervised by the Director of the MRC, Dr. William (Bill) Taylor, a full-time faculty-level staff member of the Molecular Resource Center of Excellence, and Ms. Zoe Brookover, who was recruited to in February of 2022 to replace Mr. Lorne Rose. An Internal Advisory Board (IAB) comprised of faculty members representing campus departments that use the services of the MRC has been appointed each fiscal year since FY16 by the VCR. Composition of the IAB is evaluated each fiscal year prior to member reappointment by the VCR. The IAB advises the VCR how MRC funds should be used and makes recommendations related to new equipment requests for the MRC, although final decisions are made by the Executive Director in consultation with the VCR.

MRC Internal Advisory Board, FY24

PI:	**Department Affiliation:**
Hao Chen, Ph.D.	Pharmacology
Ramesh Narayanan, Ph.D.	Medicine (*IAB CHAIR*)
Lawrence Reiter, Ph.D.	Neurology
Lu Lu, Ph.D.	Genetics, Genomics and Bioinformatics

IV. Year End Review FY23

Although it was expected that revenues would increase in FY23 over FY22 levels, as pandemic restrictions eased, this was not realized. Receivables for core services decreased in FY23 by ~33% to $137,326 from $204,424 in FY22.

In FY20, the MRC processed >13,775 service/supply requests (not including use of equipment available in the MRC at no charge); this volume decreased to 9,824 in FY21, to 9,106 in FY22 and remained stable in FY23 (9,502). During FY23, the MRC served 65 total investigators, of which 64 investigators were internal to UTHSC (98.5% of all investigators), representing the core of our currently extramurally funded investigators, and 1 external user from The University of Memphis. The large number of internal UTHSC faculty served is reflective of our continuing commitment in the MRC to providing excellence in molecular analyses, while promoting significant advances in our services related to nucleic acid sequencing, educational programs, and fostering collaboration and communication. The MRC has sufficient capacity to process a higher volume of samples for all offered services, therefore, the Executive Director increased outreach efforts in FY22-FY23 to other UT System campuses to advertise MRC services, including to UT Knoxville (UTK). UTHSC MRC core staff and leadership were invited to UTK in FY24 to spread awareness about the availability of services on the Memphis campus.

Over the past several years, the MRC committed itself to the rapidly evolving technologies of high-throughput, massively parallel nucleic acid sequencing (next-generation sequencing, NGS), also known as whole genome sequencing. To

exploit the impact of these technologies, an individual investigator can now sequence nucleic acids on a scale far exceeding that of hundreds of investigators in the human genome project of the previous decades, and in a time frame of minutes and hours instead of weeks and months. Applying NGS technologies allows the rapid analysis of genomic DNA, expressed messenger RNA, active regions of chromosomes, regions of DNA coding for proteins, modification of DNA, and other, constantly evolving molecular analyses.

From FY17 to FY22, the MRC offered two different platforms for NGS analysis, the Life Technologies platform, using the PGM and the Proton (PI) chips, or the Illumina platform. The service agreement for the PGM/Proton instruments was dropped in FY23; however, one PI was allowed to complete a legacy project. The Life Technologies NGS platform is no longer offered as of FY24. The Illumina NextSeq 500 NGS instrument was purchased by the UTHSC VC for Research for the MRC in FY17 (installed in July of 2016). Since 2017, Illumina has continued to dominate the NGS market, and the market share for Life Technologies platform has dramatically declined. With the onboarding of the NextSeq2000 mid-to-high throughput instrument in July of 2022 (FY23), we have exclusively recommended Illumina-based services for all in-house NGS projects.

Nationwide, during FY23 there was a marked increase in core facilities' use of Illumina's competitor technologies for NGS, with cores acquiring new platforms available from either Element Biosciences or Singular Genomics. The greatest potential benefit to customers is that the per sample pricing relying on the technologies offered by these vendors is approximately one-third of Illumina-based NGS services, but with equivalent read depth. Competition to the Illumina platform

is a serious, emerging threat to the MRC because as Element Biosciences and Singular capture a larger market share, we will likely lose the price-sensitive NGS customers we have tried to retain by lowering pricing with Illumina in FY23-FY24, unless we invest in instruments from Element Biosciences or Singular Genomics. A potential benefit to market competition could be that Illumina adjusts its standard NGS reagent pricing downward to entice customers to remain with Illumina, although this has not yet been observed.

Once a new VCR is recruited to UTHSC, it is likely that additional resources for capital equipment purchases will become available. Based on the feedback Dr. Seagroves and Dr. Taylor have received from genomics core facility directors across the US, the AVITI instrument from Element Biosciences is the current preferred platform. Overall, investment in the AVITI instrument is a high priority opportunity for the FY24-FY25 period in order to complete our researchers' NGS projects at the best price possible, to retain our current customer base focused on turnaround time, and to bring price-sensitive, former customers back to in-house NGS services at the MRC.

To improve the efficiency and consistency of many operations, the MRC has invested in robotic technologies. The most significant labor-intensive step in NGS lies in the bar-coded library preparation. In December 2016, we installed the Hamilton Starlet robot dedicated to NGS library preparation, which had become a bottleneck to sample processing, and, therefore, to rapidly invoicing processed NGS samples. Instead of producing 16 libraries per week using all manual labor liquid handling, the robot is capable of generating >24 libraries per day. Although originally programmed in FY18 for library prep kits available at that time, changes

in library prep steps and kits since this time led to required new investment during FY23-FY24 in new software and reprogramming upgrades to the Starlet to allow preparation of NGS libraries using current NEB brand kits or Illumina brand kits.

Dr. William Taylor, Director of the MRC and Dr. Daniel Johnson, Director of the Molecular Bioinformatics (mBIO) core are also critical assets to assist investigators with one-on-one planning of experimental design and subsequent interpretation of raw and normalized data. Consultation for project design and a general plan for statistical methods to be used for data analysis are provided at no charge to all core customers. This level of support to our researcher community is an essential component to bring researchers “back to the MRC” to meet their NGS needs, as commercial vendors are not as motivated to troubleshoot project issues.

Through the Molecular Bioinformatics (mBIO) core, we are able to support local data storage/back-up and to offer standardized workflows custom built and refined in-house to analyze investigators’ data, avoiding the need to invest in commercial data analysis software. The MRC effectively supports a breadth of investigator needs while leveraging the mBIO core’s capabilities in raw data analysis.

Conventional capillary (Sanger) sequencing of DNA was sunsetted as a MRC service in September of 2020 (FY21), when Dr. Tom Cunningham retired. In FY15, we began offering direct shipping to an external sequencing vendor, GeneWiz (now Azenta), and we began invoicing customers as a passthrough charge via the MRC. In FY19, 1,877 samples were sent to GeneWiz for Sanger sequencing, a significant increase over the FY18 volume of 417 samples, whereas 525 samples were submitted to GeneWiz in FY20, and increasing to 919 samples in FY21.

Sample volume was 2,527 in FY22 and 3,315 in FY23 when no “in-house” options were available. Competitive pricing previously negotiated with Azenta for Sanger sequencing remained fixed from FY17-FY21, but sample pricing increased during FY22-FY23 due to general inflation. Based on customer satisfaction, the Azenta contract was renewed in December of 2022.

Throughout FY18-FY23, the MRC was unable to fill an open Senior Research Assistant position vacated by Ms. Costelle in FY18, which was responsible for NGS and other molecular-based services. In the interim, Dr. Bill Taylor recruited and trained Ms. Zoe Brookover. In addition, Dr. Hilaire Smith has temporarily filled in on a part-time basis for the vacant Senior Research Assistant position. Both Zoe and Dr. Smith were trained to use iLab and to manage MRC equipment and run standard assays for customers, and were trained directly by Illumina to prepare NGS libraries. We will not fill this position with permanent staff unless sample submissions and recoveries increase in FY24 beyond FY19 levels. Therefore, a decision regarding advertising this open position will likely be deferred until a new VCR is in place, or after FY24 closes.

Quantitative real-time PCR assays (qPCR) remain important as discovery and/or validation tools for our researchers. The microarray and qPCR services were previously managed by Mr. Lorne Rose and are now managed by Ms. Zoe Brookover (Affymetrix and Roche LC480 platforms, respectively). qPCR operations continue to be in demand, however, a clerical error in FY23 led to reservations for qPCR use not being converted in billable services in the iLab software, so no revenues for instrument time were tracked or recovered. Several PIs now also house their own benchtop qPCR instruments; however, these

investigators frequently purchase their qPCR reagents (master mixes and PCR plates) directly from the MRC, which buys reagents in bulk. In FY22, $16,785 was generated from the resale of qPCR reagents, and in FY23, $11,304 was generated. The difference it total qPCR revenues was driven in part by the decrease in the total number of qPCR runs completed at the MRC between FY21 and FY22 using the two LC480 qPCR instruments.

The business administration of several institutional core facilities, including the MRC, is led by Ms. Natalie Smith (Assistant Director-Core Facilities, business manager). She is responsible for a host of functions to support the MRC, ranging from accounting, approval of expenses, contract negotiations and invoicing core users, to seminar, workshop, and conference scheduling. In March 2017, the Office of Research entered into an agreement with iLab Solutions (Agilent) to develop a web-based core laboratory management system that facilitated requesting orders by PIs, invoicing of PIs by the institutional cores' business managers and reporting on core usage by the Associate Vice Chancellor for Research. All active researchers use single sign on authentication (via their NetID) to access the iLab web interface to request services, consultation or equipment reservations at every institutional core facility except for LACU. The MRC went live with iLab in January of 2018. Since then, investigators have been able to request services, to track their project workflows, or to view their invoices within iLab. In addition, there is financial integration of iLab with IRIS, such that only active funds may be selected by PIs in advance to request core services, and such that transfer of funds from PI accounts to the core ledgers occurs seamlessly on the last day of the month in real-time (May services are billed May 31st, for example).

Since FY19, the first full fiscal year that usage and revenues data could be easily analyzed for the MRC using the iLab software interface, we have tracked service requests and invoicing for all internal users exclusively through iLab software. Another advantage of the iLab interface is that data may be quickly classified and reported in table or graph format by an individual, the PI's lab group, department, month or a specific service line. Once default reporting parameters are set, new dates can be entered to regenerate consistent reports with the same content and formatting--year over year, or period over period.

Since July of 2019, researchers' fund sources have been automatically debited via IRIS through iLab. Invoicing is now completed on the last day of the month so that completed services are invoiced within the same month (instead of a prior one-month delay in recognizing core recoveries). This workflow means that when the Assistant Director finalizes monthly invoices, funds are debited immediately from a PI's designated account without the need to process internal transfer vouchers. Overall, the adoption of iLab has dramatically streamlined the management of the MRC and saved hundreds of hours of labor per year related to processing invoices or to tracking down PIs to update incorrect information previously written on paper service request forms. Prior to iLab, typical errors were the misspelling of a PI's name, missing digits from fund sources or the use of an expired fund source. As of January 2018, paper service request forms were eliminated at the MRC. Email communications are also recommended to be sent via iLab, since the emails are permanently archived. Finally, all invoices are permanently recorded in the iLab database, which is hosted in the cloud by Agilent.

In summary, the MRC touches many investigators at many institutions. The robust performance of MRC operations reflects a growth in the incorporation of new technologies and a broad user base in the greater Memphis area.

V. Goals and objectives, FY24 (2023-2024)

The goals of the MRC in FY24 are to continue to fulfill its mission to extend and to enhance the molecular and cellular research capabilities of the Tennessee research community and to provide an education resource to that community. There are three objectives to meet these goals:

Maintain the educational component of the MRC. With technological advances occurring daily, the MRC will continue to provide educational programs to researchers to keep them abreast of developments, both current and those anticipated for the near future. In FY23, MRC hosted in-person vendor seminars on campus from Illumina and Nanostring. Throughout FY24, we plan to invite guest speakers with expertise in genomics and molecular biology to present virtual or in-person seminars to our campus and to meet with faculty/staff.

The MRC will also offer to assist local K-12 educational community members by offering exposure to molecular research technologies and research methods. For example, there may be opportunities for interacting with the Crosstown High School charter school, which is located less than one mile from the UTHSC campus. In addition, Shelby County Schools has recently partnered with the Southwest Tennessee Community College (SWTCC), located across the street from the MRC, to create a health professions track high school (the first student cohort entered during the 2021-2022 school year). The MRC will also continue to host interns from the SWTCC Biotechnology Technician program for their 14-week practical experience. Together, these educational initiatives enhance the competitiveness of research associated with the MRC and assist in workforce

development, leveraging state support to strengthen biomedical research and research training.

Since FY16, MRC has participated in “Hot Topics in Research” seminars organized by the Office of Research; one of these seminars highlighted features of the Illumina iScan and NextSeq500 instruments, and the second seminar highlighted the exciting preliminary NGS data recently generated in the MRC by the laboratories of two MRC users, Dr. Lawrence Reiter and Dr. Dave Rogers. The MRC routinely participates in faculty recruitment visits and visits to UTHSC by external Office of Research administrators to share ideas about core management. The MRC has historically hosted graduate student candidates during their on-campus interviews, and MRC has celebrated postdoc week with UTHSC postdocs by offering a tour of MRC facilities. Frequent faculty and student recruitment visits are also organized at the request of the colleges or department chairs.

Expand awareness of MRC services to potential users throughout the State of Tennessee. Although the majority of MRC users are located on, or in close proximity to, the UTHSC campus in Memphis, the MRC has started efforts to advertise our resources that are available to other researchers throughout the State. The MRC is ready to assist investigators throughout the State with their projects and to advise on project design and development. Supporting additional investigators located throughout the State will likely require coordinated on-campus visits to advertise core services, and initiation of direct contact with our colleagues at UTK and UT Chattanooga. Dr. Seagroves. As one example of relationship building, Ms. Veronica Brown, the UTK Genomics Core director, gave a webinar to our Memphis campus faculty in May of 2022 overviewing the UTK

genomics core's services, and she reviewed the onboarding of the NovaSeq6000 instrument for high-volume sequencing projects on the Knoxville campus. In FY24, Dr. Seagroves plans to travel to UTK to provide an overview of the UTHSC institutional-level core facilities available to Knoxville users, including the MRC.

Participate in execution of the newly revised UTHSC strategic plan. As one of the largest (by user base) Core facilities on campus, the MRC is in unique position to advise the executive leadership on how shared resources facilitate research progress and new discoveries. When communicating about the "Cores" to UTHSC leadership, Dr. Seagroves will interface with Dr. Taylor, the MRC staff, the MRC IAB and frequent MRC users to craft a plan for how the MRC can support molecular and genomics-based research programs over the next 5 years to support the continued growth of the research portfolio throughout the State of Tennessee.

VI. Sample Volume and Financial Summaries

Review of FY23 Sample Volumes and Core Recoveries by Application:

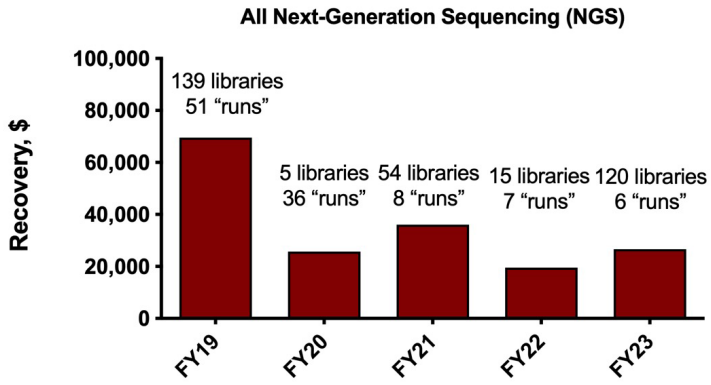


Figure 1: Five-year summary of recovery ($) and total NGS usage (sequencing run + NGS library prep sample numbers= total number of services, as listed above each bar), combining the Life Technologies or the Illumina NextSeq500 NGS platforms. The recovery data include the total number of library preps plus the number of sequencing "runs".

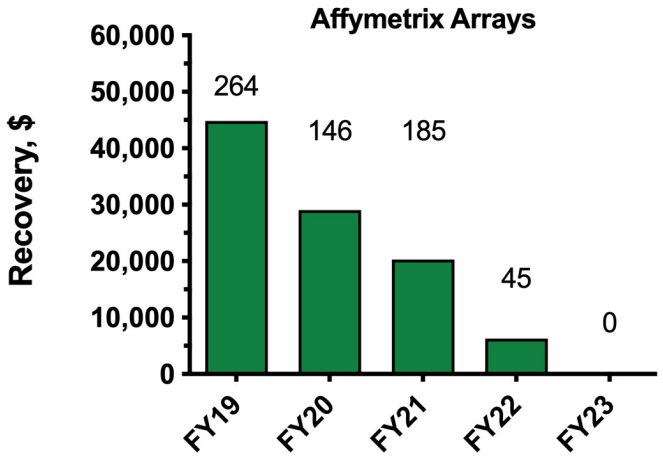


Figure 2: Five-year recovery ($) and usage (number of arrays processed is shown above each bar) for all Affymetrix microarray services. Since FY19, demand for microarray services has decreased due to a preference for NGS-based gene expression profiling. Since no samples were processed in FY23, these services will be sunsetted in FY24 as of February of 2024.

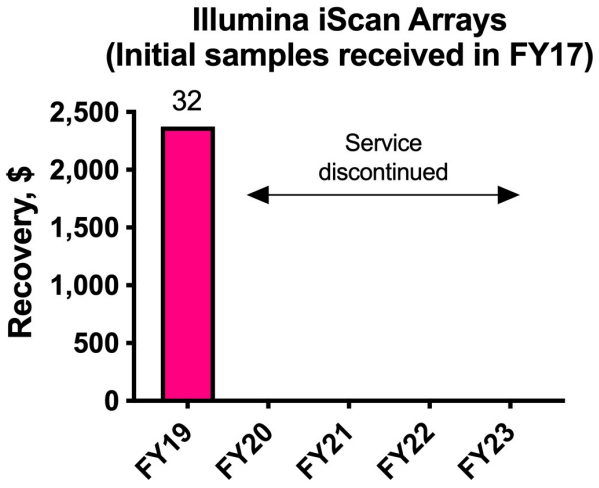


Figure 3: Five-year recovery ($) and usage (number of samples processed on iScan arrays is shown above each bar) for all Illumina iScan microarray services. Beginning in FY18, the single investigator who had used the iScan decided to purchase reagents directly from Illumina, and the investigator then only paid array processing fees to the MRC. All iScan services were discontinued in the MRC in FY20, and the iScan instrument, originally purchased as part of a recruitment packaege for a researcher in the College of Medicine (COM), was returned to COM.

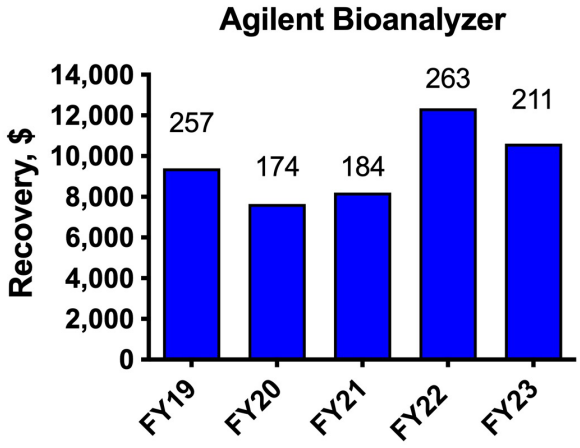


Figure 4: Five-year recovery ($) and usage (number of samples processed is shown above each bar) for the Agilent Bioanalyzer assays, which quantitate DNA and RNA and/or evaluate RNA integrity. These numbers do not include any Bioanalyzer runs that were part of our standard quality control (QC) assessment for NGS runs. Customers who use outside NGS vendors often use the Bioanalyzer services at the MRC before sending out their samples to commercial vendors for library preparation/sequencing runs.

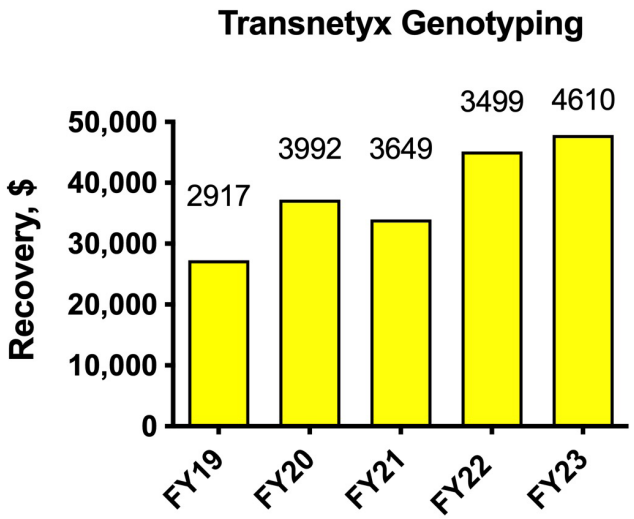


Figure 5: Five-year recovery ($) and usage (the number of samples processed is shown above each bar) for the genotyping service offered through our external genotyping vendo partner, Transnetyx. Usage and recoveries have increased since FY19.

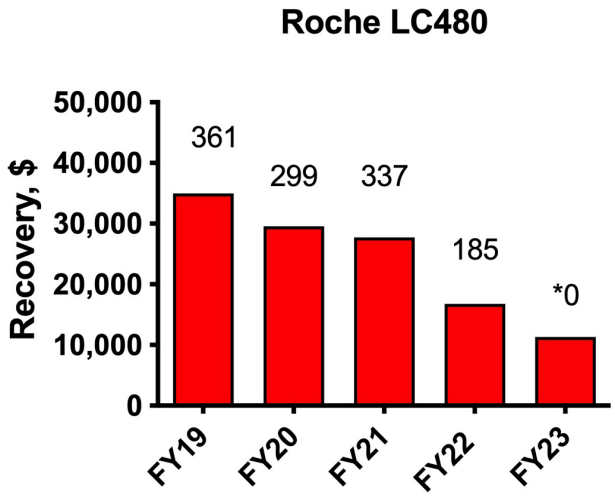


Figure 6: Five-year recovery ($) for all qPCR reagents and Roche LC480 real-time PCR plate "runs" (the number of plate runs is shown above each bar). Instrument use has declined since FY19 as more investigators purchase their own benchtop qPCR instruments. Since FY19, the volume of qPCR assay supplies and reagents purchased has also decreased. *In FY23, a clerical error lead to loss of revenues from "runs" of the instrument since instrument reservations were not converted into invoices for payment. Actual instrument use, therefore, was not tracked, and all recoveries shown in FY23 are from the sale of PCR supplies and reagents.

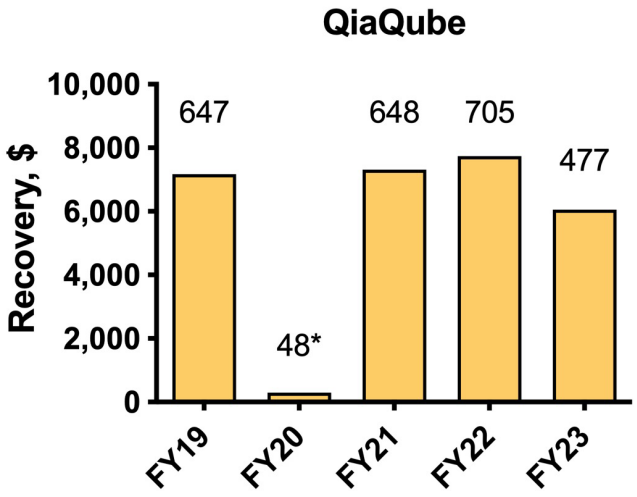


Figure 7: Five-year recovery ($) and usage (number of samples processed is shown above each bar) for the automated preparation of nucleic acids from cells, fluids or pulverized tissues using the Qiagen QiaQube instrument. For enhanced quality control prior to NGS library preparation for RNA-seq, investigators are encouraged by MRC staff to utilize the QiaQube for their preparations of DNase-treated RNA, which will also be free of other contaminants typically observed with other standard laboratory RNA extraction methods. Use of the QiaQube appeared to dramatically decrease in FY20, but the recoveries were similar in FY21 to FY19. Investigation of service records revealed an error in the FY20 reporting in iLab related to how iLab was programmed to recognize QiaCube submissions versus instrument reservations. Use of the QiaQube decreased in FY23 relative to FY22.

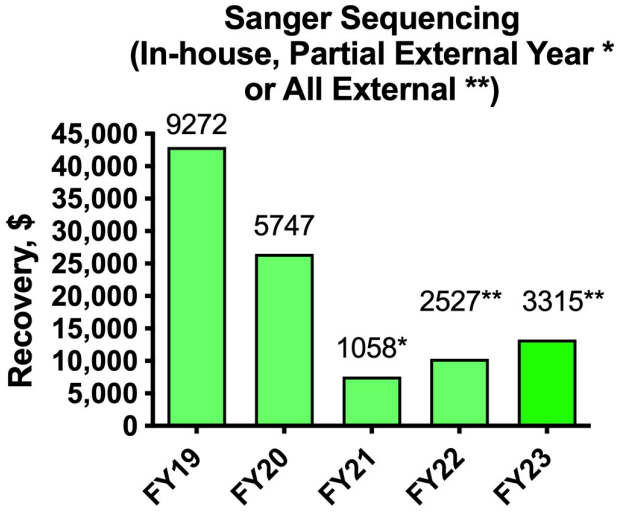


Figure 8: Five-year recovery ($) and usage (number of samples processed is shown above each bar) for Sanger sequencing. Revenues peaked in in FY19 before to decreasing to levels in FY22 more similar to FY21. Notations: *FY21: Volume during transition year from in-house to GeneWiz. Sanger sequencing services at the MRC were sunsetted on September 15, 2020; **Data includes only the services offered externally through the GeneWiz/Azenta contract at the MRC.

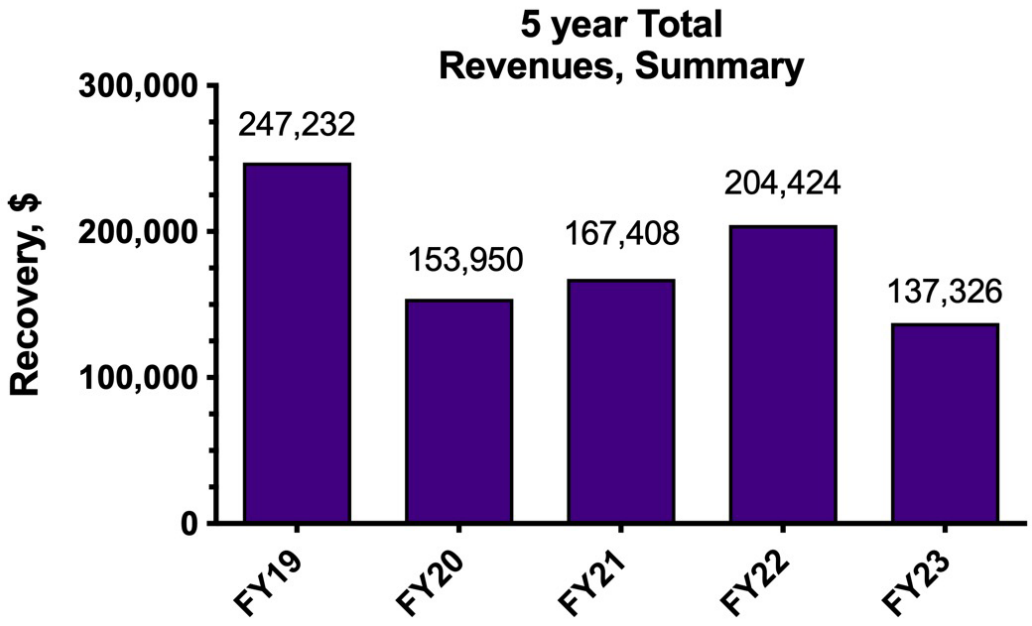


Figure 9: Total recovery ($) for the MRC since FY19. Overall, revenues have decreased since FY19 as more customers selected commercial vendors for NGS services and the use of microarrays coconmitantly declined. Revenues for FY21 increased ~9% over FY20 levels, and revenues increased ~22% from FY21 to FY22 In FY20-FY21, relative to FY19, total revenues declined relative to FY19 since laboratory research was interrupted due to the COVID-19 pandemic. Revenues decreased in FY23 relative to FY22, predominantly due to staff shortages and the prolonged time to prepare NGS libraries to complete NGS projects before the Hamilton robots had been reprogrammed (starting in June of 2023). Several NGS invoices were delayed for payment until project completion, which occurred in early FY24; recoveries from those projects will be reflected in the FY24 financial data.

VII. MRC Assisted Investigators FY23, July 2022-June 2023

Principal Investigator:	Department:	College:
Fletcher, Max	Anatomy & Neurobiology	Medicine
Heck, Detlef H.	Anatomy & Neurobiology	
Kim, Il Hwan	Anatomy & Neurobiology	
Johnson, Rajasingh	Bioscience Research	Dentistry
Fortwendel, Jarrod	Clinical Pharmacy	Pharmacy
Palmer, Glen	Clinical Pharmacy	
Mohamed, Junaith Shai	Diagnostic & Health Sciences	Health Professions
Ashbrook, David	Genetics, Genomics and Informatics	Medicine
FreeFreeman, Kevin	Genetics, Genomics and Informatics	
Jones, Byron	Genetics, Genomics and Informatics	
Lu Lu	Genetics, Genomics and Informatics	
Mozhui, Khyobeni	Genetics, Genomics and Informatics	
Mulligan, Megan	Genetics, Genomics and Informatics	
Sharp, Bert	Genetics, Genomics and Informatics	
Starland-Davenport, Athena	Genetics, Genomics and Informatics	
Williams, Robert W.	Genetics, Genomics and Informatics	
Kovesdy, Csaba	Medicine	Medicine
Kuscu, Cem	Medicine	
Makowski, Liza	Medicine	
Narayanan, Ramesh	Medicine	
Quarles, Leigh D.	Medicine	
Cox, John	Microbiology, Immunology and Biochemistry (MIB)	Medicine
Fitzpatrick, Elizabeth	MIB	
Gomes-Solecki, Maria	MIB	
Jonsson, Colleen	MIB	
Li, Kui	MIB	
Pourmotabbed, Tayebeh	MIB	
Radic, Marko	MIB	
Yi, Ae-Kyung	MIB	
Khan, Mohammad	Neurology	Medicine
Reiter, Lawrence	Neurology	
Xiao, Jianfeng	Neurology	
Gangaraju, Raja Shekhar	Ophthalmology	Medicine
Jablonski, Monica	Ophthalmology	
Krum (Miranda), Susan	Orthopaedic Surgery	Medicine

Laribee, Ronald	Pathology	Medicine
Seagroves, Tiffany	Pathology	
Yue, Junming	Pathology	
Purevjav, Enkhsaikhan	Pediatrics	Medicine
Samarasinghe, Amali	Pediatrics	
Towbin, Jeffrey A.	Pediatrics	
Collier, Daniel	Pharmaceutical Sciences	Pharmacy
Hevener, Kirk	Pharmaceutical Sciences	
Li, Wei	Pharmaceutical Sciences	
Park, Frank	Pharmaceutical Sciences	
Singla, Bhupesh	Pharmaceutical Sciences	
Bahouth, Suleiman	Pharmacology	Medicine
Bukiya, Anna	Pharmacology	
Chen, Hao	Pharmacology	
Dopico, Alex	Pharmacology	
Jee, Chang Hoon	Pharmacology	
Liao, Francesca-Fang	Pharmacology	
Malik, Kafait U.	Pharmacology	
Sakata, Kazuko	Pharmacology	
Tavalin, Steve	Pharmacology	
Alway, Stephen	Physical Therapy	Health Professions
Adebiyi, Adebowale	Physiology	Medicine
Cordero-Morales, Julio	Physiology	
Jaggar, Jonathan	Physiology	
Lebeche, Djamel	Physiology	
Mancarella, Salvatore	Physiology	
Rao, R.K.	Physiology	
Tigyi, Gabor	Physiology	
Gosain, Ankush	Surgery	Medicine
Shibata, David	Surgery	

MRC-Assisted External Investigators

Principal Investigator:	**Entity:**
Parrill-Baker, Abby	University of Memphis, Memphis, TN

VIII. Publications Supported by the MRC in FY23

Publications from July 1, 2022 to June 30, 2023. MRC users are bolded.

1) Bou Sleiman M, Roy S, Gao AW, Sadler MC, von Alvensleben GVG, Li H, Sen S,Harrison DE, Nelson JF, Strong R, Miller RA, Kutalik Z, **Williams RW**, Auwerx J.Sex- and age-dependent genetics of longevity in a heterogeneous mousepopulation. Science. 2022 Sep 30;377(6614):eabo3191. doi:10.1126/science.abo3191. Epub 2022 Sep 30. PMID: 36173858; PMCID: PMC9905652.

2) Karki R, Lee S, Mall R, Pandian N, Wang Y, Sharma BR, Malireddi RS, Yang D,Trifkovic S, Steele JA, Connelly JP, Vishwanath G, Sasikala M, Reddy DN, VogelP, Pruett-Miller SM, Webby R, **Jonsson CB**, Kanneganti TD. ZBP1-dependent inflammatory cell death, PANoptosis, and cytokine storm disrupt IFN therapeuticefficacy during coronavirus infection. Sci Immunol. 2022 Aug 26;7(74):eabo6294.doi: 10.1126/sciimmunol.abo6294. Epub 2022 Aug 26. PMID: 35587515; PMCID:PMC9161373.

3) Earley CJ, **Jones BC**, Ferré S. Brain-iron deficiency models of restless legssyndrome. Exp Neurol. 2022 Oct;356:114158. doi: 10.1016/j.expneurol.2022.114158.Epub 2022 Jun 30. PMID: 35779614; PMCID: PMC9357217.

4) Thiyagarajan T, Ponnusamy S, Hwang DJ, He Y, Asemota S, Young KL, Johnson DL,Bocharova V, Zhou W, Jain AK, Petricoin EF, Yin Z, Pfeffer LM, Miller DD,**Narayanan R**. Inhibiting androgen receptor splice variants with cysteine-selective irreversible covalent inhibitors to treat prostate cancer. Proc NatlAcad Sci U S A. 2023 Jan 3;120(1):e2211832120. doi: 10.1073/pnas.2211832120.Epub 2022 Dec 28. PMID: 36577061; PMCID: PMC9910435.

5) **Alway SE**, Paez HG, Pitzer CR, Ferrandi PJ, **Khan MM**, **Mohamed JS**, Carson JA,Deschenes MR. Mitochondria transplant therapy improves regeneration andrestoration of injured skeletal muscle. J Cachexia Sarcopenia Muscle. 2023Feb;14(1):493-507. doi: 10.1002/jcsm.13153. Epub 2023 Jan 5. PMID: 36604839;PMCID: PMC9891964.

6) McDaniels JM, Shetty AC, **Kuscu C**, Kuscu C, Bardhi E, Rousselle T, Drachenberg C, Talwar M, Eason JD, Muthukumar T, Maluf DG, Mas VR. Single nuclei transcriptomics delineates complex immune and kidney cell interactions contributing to kidney allograft fibrosis. Kidney Int. 2023Jun;103(6):1077-1092. doi: 10.1016/j.kint.2023.02.018. Epub 2023 Feb 28. PMID:36863444; PMCID: PMC10200746.

7) Miao Y, Konno Y, Wang B, Zhu L, Zhai T, Ihira K, Kobayashi N, Watari H, JinX, **Yue J**, Dong P, Fang M. Integrated multi-omics analyses and functionalvalidation reveal TTK as a novel EMT activator for endometrial cancer. J TranslMed. 2023 Feb 25;21(1):151. doi: 10.1186/s12967-023-03998-8. PMID: 36829176;PMCID: PMC9960418.

8) Chen X, Chen L, Lin G, Wang Z, Kodali MC, Li M, Chen H, Lebovitz SG, OrtylTC, Li L, Ismael S, Singh P, **Malik KU**, Ishrat T, Zhou FM, Zheng W, **Liao FF**. White matter damage as a consequence of vascular dysfunction in a spontaneous mouse model of chronic mild chronic hypoperfusion with eNOS deficiency. Mol Psychiatry. 2022 Nov;27(11):4754-4769. doi: 10.1038/s41380-022-01701-9. Epub2022 Aug 10. PMID: 35948662; PMCID: PMC9734049.

9) Johnson GA, Tian Y, **Ashbrook DG**, Cofer GP, Cook JJ, Gee JC, Hall A, HornburgK, Kaczorowski CC, Qi Y, Yeh FC, Wang N, White LE, **Williams RW**. Merged magnetic resonance and light sheet microscopy of the whole mouse brain. Proc Natl AcadSci U S A. 2023 Apr 25;120(17):e2218617120. doi: 10.1073/pnas.2218617120. Epub2023 Apr 17. Erratum in: Proc Natl Acad Sci U S A. 2023 Jun20;120(25):e2308718120. PMID: 37068254; PMCID: PMC10151475.

10) **Radic M**, Muller S. LL-37, a Multi-Faceted Amphipathic Peptide Involved inNETosis. Cells. 2022 Aug 8;11(15):2463. doi: 10.3390/cells11152463. PMID:35954305; PMCID: PMC9368159.

11) Pervaiz N, Kathuria I, Aithabathula RV, **Singla B**. Matricellular proteins inatherosclerosis development. Matrix Biol. 2023 Jun;120:1-23. doi:10.1016/j.matbio.2023.04.003. Epub 2023 Apr 20. PMID: 37086928; PMCID:PMC10225360.

12) Bohm MS, Sipe LM, Pye ME, Davis MJ, Pierre JF, **Makowski L**. The role ofobesity and bariatric surgery-induced weight loss in breast cancer. Cancer Metastasis Rev. 2022 Sep;41(3):673-695. doi: 10.1007/s10555-022-10050-6. Epub2022 Jul 23. PMID: 35870055; PMCID: PMC9470652.

13) **Laribee RN**, Boucher AB, Madireddy S, Pfeffer LM. The STAT3-Regulated Autophagy Pathway in Glioblastoma. Pharmaceuticals (Basel). 2023 Apr29;16(5):671. doi: 10.3390/ph16050671. PMID: 37242454; PMCID: PMC10223172.

14) de Jong TV, **Chen H**, Brashear WA, Kochan KJ, Hillhouse AE, Zhu Y, Dhande IS, Hudson EA, Sumlut MH, Smith ML, Kalbfleisch TS, Doris PA. mRatBN7.2: familiar and unfamiliar features of a new rat genome reference assembly. PhysiolGenomics. 2022 Jul 1;54(7):251-260. doi: 10.1152/physiolgenomics.00017.2022.Epub 2022 May 11. PMID: 35543507; PMCID: PMC9236863.

15) **Park F**. The heart is where AAV9 lies. Physiol Genomics. 2022 Aug1;54(8):316-318. doi: 10.1152/physiolgenomics.00102.2022. Epub 2022 Jul 11.PMID: 35816650.

16) Yu Y, **Li W**, Jiang J. TRPC channels as emerging targets for seizuredisorders. Trends Pharmacol Sci. 2022 Sep;43(9):787-798. doi:10.1016/j.tips.2022.06.007. Epub 2022 Jul 12. PMID: 35840362; PMCID: PMC9378536.

17) Marathe SJ, Snider MA, Flores-Torres AS, Dubin PJ, **Samarasinghe AE**. Human matters in asthma: Considering the microbiome in pulmonary health. Front Pharmacol. 2022 Dec 2;13:1020133. doi: 10.3389/fphar.2022.1020133. PMID:36532717; PMCID: PMC9755222.

18) Patel PS, Castelow C, Patel DS, Bhattacharya SK, **Kuscu C**, Kuscu C, **Makowski L**, Eason JD, Bajwa A. Mitochondrial Role in Oncogenesis and Potential Chemotherapeutic Strategy of Mitochondrial Infusion in Breast Cancer. Int J Mol Sci. 2022 Oct 27;23(21):12993. doi: 10.3390/ijms232112993. PMID: 36361782;PMCID: PMC9658440.

19) Manley A, Meshkat BI, **Jablonski MM**, Hollingsworth TJ. Cellular and Molecular Mechanisms of Pathogenesis Underlying Inherited Retinal Dystrophies. Biomolecules. 2023 Feb 1;13(2):271. doi: 10.3390/biom13020271. PMID: 36830640;PMCID: PMC9953031.

20) **Bahouth SW**, Nooh MM, **Mancarella S**. Involvement of SAP97 anchored multiprotein complexes in regulating cardiorenal signaling and trafficking networks. Biochem Pharmacol. 2023 Feb;208:115406. doi:10.1016/j.bcp.2022.115406. Epub 2022 Dec 31. PMID: 36596415.

21) Butler MG, Victor AK, **Reiter LT**. Autonomic nervous system dysfunction inPrader-Willi syndrome. Clin Auton Res. 2023 Jun;33(3):281-286. doi:10.1007/s10286-022-00909-7. Epub 2022 Dec 14. PMID: 36515769.

22) Shoraka S, **Samarasinghe AE**, Ghaemi A, Mohebbi SR. Host mitochondria: more than an organelle in SARS-CoV-2 infection. Front Cell Infect Microbiol. 2023 Aug25;13:1228275. doi: 10.3389/fcimb.2023.1228275. PMID: 37692170; PMCID:PMC10485703.

23) Albadari N, **Li W**. Survivin Small Molecules Inhibitors: Recent Advances and Challenges. Molecules. 2023 Feb 1;28(3):1376. doi: 10.3390/molecules28031376.PMID: 36771042; PMCID: PMC9919791.

24) Kumar S, **Singla B**, Singh AK, Thomas-Gooch SM, Zhi K, Singh UP. Hepatic, Extrahepatic and Extracellular Vesicle Cytochrome P450 2E1 in Alcohol and Acetaminophen-Mediated Adverse Interactions and Potential Treatment Options.Cells. 2022 Aug 23;11(17):2620. doi: 10.3390/cells11172620. PMID: 36078027;PMCID: PMC9454765.

25) Mitachi K, Mingle D, Effah W, Sánchez-Ruiz A, **Hevener KE**, **Narayanan R**, Clemons WM Jr, Sarabia F, Kurosu M. Concise Synthesis of Tunicamycin V and Discovery of a Cytostatic DPAGT1 Inhibitor. Angew Chem Int Ed Engl. 2022 Aug1;61(31):e202203225. doi: 10.1002/anie.202203225. Epub 2022 Jun 10. PMID:35594368; PMCID: PMC9329268.

26) Silva V, **Radic M**. COVID-19 Pathology Sheds Further Light on Balance between Neutrophil Proteases and Their Inhibitors. Biomolecules. 2022 Dec 30;13(1):82.doi: 10.3390/biom13010082. PMID: 36671467; PMCID: PMC9855895.

27) **Starlard-Davenport A**, Gu Q, Pace BS. Targeting Genetic Modifiers of HBG Gene Expression in Sickle Cell Disease: The miRNA Option. Mol Diagn Ther. 2022Sep;26(5):497-509. doi: 10.1007/s40291-022-00589-z. Epub 2022 May 12. PMID:35553407; PMCID: PMC9098152.

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IX. GRANTS and CONTRACTS SUPPORTED BY THE MRC in FY23 (71 active awards from July 1, 2022 to June 30, 2023)

Adebiyi, Adebowale

USPHS Grant R01 DK-120595, Vascular ion channels and microcirculation in neonatal urinary tract obstruction

USPHS Grant HL-151735, Control of microvascular function by ion channels

Ashbrook, David

USPHS Grant AG-075813, The interaction effects of genetic variants, age, diet, sex and mitochondrial copy number on Alzheimer's disease, aging-phenotypes and longevity

Bukiya, Anna

USPHS Grant AA-029673, Fetal cerebral arteries and prenatal alcohol exposure

Chen, Hao

USPHS Grant DA-048017, Reduced complexity mapping of oxycodone self-administration and stress responsiveness in rats

UCSD subaward to USPHS Grant DA-037844, System genetics of menthol and nicotine addiction

Boston University subaward to USPHS Grant DA-055299, Systems genetics of premorbid risk and cocaine use traits in a rat reduced complexity cross

Collier, Daniel

USPHS Grant HL-133451, Trauma Induced Endothelial Cell Ca2+ Signaling

Cordero-Morales, Julio

USPHS Grant GM-125629, The Role of Bioactive Lipids in Transient Receptor Potential Channels Gating

Cox, John

NSF Grant MCB-1817578, Mechanism of Polarized Budding in Chlamydia

University of Nebraska Subcontract Award to USPHS Grant GM-124798, Polarized Chlamydial Cell Division in the Absence of FtsZ

Davenport, Athena S

USPHS Grant DK-144641, MicroRNA-based epigenetic approach to induce fetal hemoglobin

Dopico, Alejandro

USPHS Grant HL-147315, Regulation of arterial diameter through specific sensing of endogenous steroids and novel nonsteroidal analogs by BK channel subunits.

USPHS Grant HL-148941, Cholesterol regulation of smooth muscle BK channel proteins and consequent control of cerebral artery diameter

Fortwendel, Jarrod

USPHS Grant AI-143197, Non-cyp51A-mutation Mediated Triazole Resistance in Aspergillus fumigatus

USPHS Grant AI-158442, Unlocking the cidal activity of echinocandins against Aspergillus fumigatus

Freeman, Kevin

USPHS Grant CA-216394, Dissecting the contribution of the transcriptional regulators of SNS fate to neuroblastoma oncogenesis

Gangaraju, Raja Shekhar

USPHS Grant NS-127924, Regulation of Mesenchymal Stem Cell Secretome for Treatment of Microglia Damage in Traumatic Brain Injury

Gomes-Solecki, Maria

University of Iowa-Subcontract to USPHS Grant AI-139267, Field trial and modeling of transmission-blocking vaccine to prevent Lyme disease

Gosain, Ankush

USPHS Grant DK-125047, Dysbiosis in Hirschsprung Associated Enterocolitis Pathogenesis

Heck, Detlef

USPHS Grant MH112143, Neuronal mechanisms of cerebellar cognitive function

Hevener, Kirk

Department of Defense Grant W81XWH2010296, Development and evaluation of inhibitors of the C. difficile enzyme, FabK, as microbiome-sparing antibacterials

Jablonski, Monica

USPHS Grant EY-029950, Novel Extended Release Glaucoma Therapy for Once Daily Dosing

Jaggar, Jonathan

USPHS Grant HL-133256, Blood pressure regulation by smooth muscle cell ion channels

USPHS Grant HL-155180, PKD proteins in endothelial cells

USPHS Grant HL-158846, SK3 channel trafficking in endothelial cells

USPHS Grant HL-166411, Chloride channels in endothelial cells

Johnson, Rajasingh

USPHS Grant HL-141345, scaRNA Modified Induced Pluripotent Stem Cell-Derived Cardiomyocytes or Exosomes Therapy for Chronic Ischemic Cardiomyopathy Patients

Jonsson, Colleen

USPHS Grant AI-142762, Center of Excellence for Encephalitic Alphavirus Therapeutics [CEEAT]

FDA Grant 75F40121C00154, Evaluation of Small Animal Models for COVID-19 and their application in Nonclinical Safety and Efficacy Studies of Investigational Therapeutics

CFD Research Corp/Department of Defense, Producing Biosynthetic Therapeutics from Extreme Microbiomes

Khan, Mohammad Moshahid

USPHS Grant NS-114616, Examining Progression of a Neurodegenerative Disorder

USPHS Grant AG-075597, Development of a novel gene therapy for the treatment of tauopathy

University of Rio Grande Valley subaward to Alzheimer's Foundation, LncRNA Malat1 as a potential therapeutic target for Alzheimer's Disease

Kim, Il Hwan

USPHS Grant MH-117429, Genes, Neural Circuits and Behavior

USPHS Grant MH-117429, Losing specificity: the role of the locus coeruleus in age-related distractibility

Laribee, Ronald

USPHS Grant CA-233028, Endolysosomal-nuclear communication mediated through V-ATPase and NHE9 dependent epigenetic signaling

USPHS Grant GM-138393, Mechanisms of cell signaling regulation by the Ccr4-Not complex

Lebeche, Djamel

USPHS Grant DK-111417, A Novel Role for DLK1 in Fibrotic Remodeling

Li, Kui

USPHS Grant AI-171779, Host genetic determinants regulating susceptibility/resistance to SARS-CoV-2

Li, Wei

Sponsored research grant by Veru Inc., Veru-111 & Analogs

Department of Defense Grant W81XWH2010011, Discovery of Orally Bioavailable Tubulin Inhibitors to Overcome Taxane Resistance in Metastatic Breast Cancer

Liao, Francesca-Fang

USPHS Grant AG-058467, Novel mechanistic link between metabolic changes and dementia potential role of miRNA21

USPHS Grant NS-120327, Blood-brain-barrier and white matter mechanisms underlying dementia

Makowski (Hayes), Liza

USPHS Grant CA-262112, Determining susceptibility loci in triple negative breast cancer using a novel pre-clinical model

USPHS Grant CA-253329, Role of microbial-modulated bile acid receptor signaling in breast cancer

Malik, Kafait

USPHS Grant HL-019134, Angiotensins, Prostaglandins, Adrenergic Interactions

Mancarella, Salvatore

USPHS Grant HL-153638, Defining the roles of Orai3 channel in cardiomyocytes and cardiomyopathy.

Miranda (Krum), Susan

Sarcoma Foundation of America, Analysis of Cancer Health Disparities in Osteosarcoma by scRNA-seq

Mozhui, Khyobeni

USPHS Grant AG-066625, Functional genetic analysis of epigenetic age acceleration and the regulatory landscape of the methylome

Narayanan, Ramesh
Department of Defense Grant W81XWH2110055, Androgen Receptor-Targeted Treatment for Therapeutically Challenging Breast Cancer

Nowak Jr, Thaddeus S

USPHS Grant NS-113957, Genetics of stroke vulnerability in C57BL/6 mouse substrains

Palmer, Glen

USPHS Grant AI-156611, Examining the importance of folate biosynthetic enzymes in infectious fungi

USPHS Grant AI-127607, Broad spectrum antifungals targeting fatty acid biosynthesis

Quarles, Leigh (Darryl)

USPHS Grant DK-120567, Genetic and Environmental Determinants of GPRC6A Regulation of Energy Metabolism Using Genetically Engineered Mice and Systems Biology.

USPHS Grant DK-121132, Optimization of Novel Small Molecules to Antagonize FGF-23

Radic, Marko

Triumvira Immunologies, Sponsored Research Agreement, Evaluation of Anti-CD19 TAC-T cell Efficacy in SLE Patient Cell Cultures

Rao, Radhakrishna

USPHS Grant DK-055532, Intestinal Mucosal Protection by Epidermal Growth Factor

USPHS Grant AA-029270, Defining the Role of Intestinal Calcium Channels in Alcoholic Liver Damage

USPHS Grant AI-170019, Radiation-Induced Paneth Cell Dysfunction

Reiter, Lawrence

USPHS Grant NS-115776, The role of UBE3A in gliopathic seizures.

Foundation for Prader-Willi Research, Analysis of Delayed Neural Development in PWS DPSC Derived Neurons

Sakata, Kazuko

USPHS Grant NS-101703, Heat shock factor HSF1 regulation of promoter-specific BDNF transcription

Seagroves, Tiffany

Department of Defense Grant W81XWH2010019, Discovery of Orally Bioavailable Tubulin Inhibitors to Overcome Taxane Resistance in Metastatic Breast Cancer (Partnering PI)

Sharp, Burt

USPHS Grant DA-053672, Genetics of oxycodone intake in a hybrid rat diversity panel

Sumida, Keiichi

USPHS Grant DK-125586, Circulating microbiome and premature mortality in hemodialysis patients

Tavalin, Steven

USPHS Grant MH-130678, Actions of proline at receptors and synapses

USPHS Grant AG-065813, Amyloid precursor protein control of NMDA receptor signaling

Tigyi, Gabor

USPHS Grant CA-092160, Anticancer Strategies Targeting the Autotaxin-LPA Receptor Axis

Towbin, Jeffrey Allen

USPHS Grant HL-151438, Discovery of modifier genes in cardiomyopathy

Yi, Ae-Kyung

USPHS Grant AR-069010, Inhibitory Receptors and Autoimmune Arthritis

APPENDICES:

Schedule 7

CENTERS OF EXCELLENCE ACTUAL, PROPOSED, AND REQUESTED BUDGET

Institution: University Of Tennessee Health Science Center

Center: R079700143 Molecular Res-Ctr of Excellence

	FY 2022-23 Actual			FY 2023-24 Proposed			FY 2024-25 Requested		
	Matching	Appropr.	Total	Matching	Appropr.	Total	Matching	Appropr.	Total
Expenditures									
Salaries									
Faculty			**$0**			**$0**			**$0**
Other Professional	$281,639	$281,751	**$563,390**	$290,088	$290,203	**$580,292**	$304,593	$304,714	**$609,306**
Clerical/ Supporting	$20,649	$20,649	**$41,298**	$21,268	$21,268	**$42,537**	$22,332	$22,331	**$44,663**
Assistantships			**$0**			**$0**			**$0**
Total Salaries (exclude Longevity)	**$302,288**	**$302,400**	**$604,688**	**$311,357**	**$311,472**	**$622,828**	**$326,924**	**$327,045**	**$653,970**
Longevity (Excluded from Salaries)	$4,478	$4,478	**$8,956**	$4,612	$4,612	**$9,225**	$4,843	$4,843	**$9,686**
Fringe Benefits	$93,981	$93,981	**$187,962**	$96,800	$96,800	**$193,601**	$101,640	$101,640	**$203,281**
Total Personnel	**$400,747**	**$400,858**	**$801,605**	**$412,769**	**$412,884**	**$825,654**	**$433,408**	**$433,528**	**$866,936**
Non-Personnel									
Travel	$2,475	$3,290	**$5,765**	$2,549	$3,389	**$5,938**	$2,676	$3,558	**$6,235**
Software		$457	**$457**	$0		**$0**			**$0**
Books & Journals			**$0**			**$0**			**$0**
Other Supplies	$386,275	$297,153	**$683,428**	$397,863	$260,680	**$658,543**	$417,756	$262,819	**$680,575**
Equipment	$293,705		**$293,705**	$302,516	$45,859	**$348,375**	$317,642	$35,500	**$353,142**
Maintenance	$92,657	$12,573	**$105,230**	$95,437	$32,496	**$127,933**	$100,209	$34,121	**$134,330**
Scholarships			**$0**			**$0**			**$0**
Consultants			**$0**			**$0**			**$0**
Other (Specify):									
Printing, Duplicating, Binding	$153	$153	**$307**	$158	$158	**$316**	$166	$166	**$332**
Postage, Freight, & Telephone	$933	$933	**$1,866**	$961	$962	**$1,923**	$1,009	$1,010	**$2,019**
Professional Serv & Memberships	$197,846	$104,139	**$301,985**	$203,781	$107,263	**$311,044**	$213,970	$112,626	**$326,596**
Computer Services			**$0**	$0		**$0**			**$0**
Rentals	$390	$390	**$780**	$402	$402	**$803**	$422	$422	**$844**
Grants & Subsidies			**$0**			**$0**			**$0**
Contractual & Special Services	$229		**$229**	$236	$236	**$472**	$247	$0	**$247**
Other Expenditures	$1,250	$664	**$1,914**	$1,288	$785	**$2,073**	$1,352	$824	**$2,177**
Entertainment, Food & Housing			**$0**			**$0**			**$0**
Facilities & Admin			**$0**			**$0**			**$0**
Direct Cost Sharing		-$137,326	**-$137,326**		-$122,435	**-$122,435**		-$136,378	**-$136,378**
Total Non-Personnel	**$975,913**	**$282,426**	**$1,258,339**	**$1,005,191**	**$329,794**	**$1,334,986**	**$1,055,451**	**$314,668**	**$1,370,119**
GRAND TOTAL	**$1,376,660**	**$683,285**	**$2,059,945**	**$1,417,961**	**$742,679**	**$2,160,639**	**$1,488,859**	**$748,197**	**$2,237,055**
Revenue									
New State Appropriation		$688,330	**$688,330**		$712,518	**$712,518**		$748,144	**$748,144**
Carryover State Appropriation		$25,116	**$25,116**		$30,161	**$30,161**			**$0**
New Matching Funds	$1,376,660		**$1,376,660**	$1,417,961		**$1,417,961**	$1,488,859		**$1,488,859**
Carryover from Previous Matching Funds			**$0**	$0		**$0**	$0		**$0**
Total Revenue	**$1,376,660**	**$713,446**	**$2,090,106**	**$1,417,961**	**$742,679**	**$2,160,640**	**$1,488,859**	**$748,144**	**$2,237,003**

Molecular Resource Center of Excellence Personnel
FY23 (2022-2023)

Institution:	The University of Tennessee Health Science Center, Memphis, TN
Center of Excellence:	Molecular Resource Center (MRC)

Personnel:

Tiffany Seagroves, Ph.D.	Executive Director and Associate Vice Chancellor for Research Core Laboratories
William Taylor, Ph.D.	Director; Microarray, Whole Genome Sequencing and RNA analysis
Zoe Brookover	Senior Research Specialist; Microarrays technician/analyst and NGS assistance
Temporary staff*	Senior Research Assistant
Natalie Smith	Assistant Director (Core Laboratories)

*filled part-time by Dr. Hilaire Smith

Personnel Summary:

Appropriated costs for 2022-2023	$400,858
Matching funds for 2022-2023	$400,747
Total costs for 2022-2023	**$801,605**

Molecular Resource Center of Excellence
Proposed Core Personnel - FY24 (2023-2024)

Institution:	The University of Tennessee Health Science Center, Memphis, TN
Center of Excellence:	Molecular Resource Center (MRC)
Personnel:	
Tiffany Seagroves, Ph.D.	Executive Director and Associate Vice Chancellor for Research Core Laboratories
William Taylor, Ph.D.	Director; Microarray, Whole Genome Sequencing and RNA analysis
Zoe Brookover	Senior Research Specialist; Microarrays technician/analyst and NGS assistance
Temporary staff*	Senior Research Assistant *currently filled part-time by Dr. Hilaire Smith
Natalie Smith	Assistant Director (Core Laboratories)

Personnel Summary:

Appropriated costs for 2023-2024	$412,884
Matching funds for 2023-2024	$412,769
Total costs for 2023-2024	**$825,654**

Molecular Resource Center of Excellence
Non-Personnel Actual and Proposed Budget Summaries
and Actual Appropriated Funds and Matching Funds Summary

Actual 2022-2023 Non-Personnel Total Budget

Travel	$ 5,765
Software	$ 457
Supplies	$ 683,428
Equipment	$ 293,705
Maintenance	$ 105,230
Printing, Duplicating, Binding	$ 307
Postage, Freight & Telephone	$ 1866
Contract/Special Services	$ 229
Prof Services and Membership	$ 301,985
Rentals & Insurance	$ 780
Direct Cost Sharing	$ (137,326)
Other Expenses	$ 1914
Total	**$ 1,258,339**

Non-Personnel Summary	
Appropriated funds for 2022-2023	$ 282,426
Matching funds for 2022-2023	$ 975,913
Total funds for 2022-2023	**$ 1,258,339**

Proposed 2023-2024, FY24 Non-Personnel Budget

Travel	$ 2,549
Software	$ 0
Supplies	$ 658,453
Equipment	$ 348,375
Maintenance	$ 127,933
Printing, Duplicating, Binding	$ 316
Postage, Freight & Telephone	$ 1923
Contract/Special Services	$ 472
Prof Services and Membership	$ 311,044
Rentals & Insurance	$ 803
Direct Cost Sharing	$ (122,435)
Other Expenses	$ 2073
Total	**$ 1,334,986**

Non-Personnel Summary, Proposed	
Appropriated funds for 2023-2024	$ 329,794
Matching funds for 2023-2024	$ 1,005,191
Total funds for 2023-2024	**$ 1,334,986**

Actual 2022-2023 Appropriated Funds and Matching Funds

Total Appropriated Funds 2022-2023	$ 688,330
Carry Over of 2021-2022 funds	$ 25,116
Total Appropriation 2022-2023	$ 713,446
Total Matching funds 2022-2023	$1,376,660
Total Operating Budget, 2022-2023	**$2,090,106**