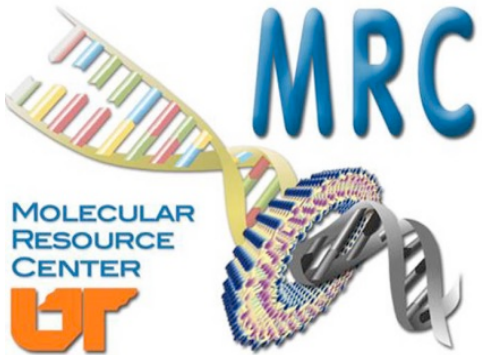

Molecular Resource Center of Excellence
2021–2022 Annual Report to the Tennessee Higher Education Commission

October 18, 2022

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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 core customers.

In FY22, as laboratories recovered from the COVID-19 pandemic, the MRC generated more recoveries ($204,424) than in either FY21 ($154,268) or FY20 ($153,950). Concordantly, extramural grant and contract awards on the UTHSC campus increased again in FY22 to $133,973,000, which is a $7.27 million increase over FY21's final value of $126,700,000. Although there has been year-over-year growth in grants and contracts on the UTHSC Memphis campus since F17 (~$85,000,000 total for grants and contracts), in general, the total volume of samples processed at the MRC has decreased each year from FY17-FY22. In

addition, as has been observed since the FY18 period, the majority of investigators we historically served for performing their whole-genome, NGS projects selected commercial vendors instead of the MRC. These decisions have been primarily based on 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 with each other for academic business by offering “new customer” bulk order discount pricing, in addition to 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-FY22, 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. However, the revenues from NGS over a 5 year period from FY18-FY22 reached the lowest level in FY22, with $19,505 in recoveries and only 15 libraries prepared for NGS services, with 7 “runs”, below levels for either FY20 ($25,685) or FY21 ($36,083). During this time, the MRC has primarily served customers who require rapid turnaround time; these investigators are time-sensitive rather than price-sensitive for NGS projects.

To meet the budget constraints of our price-sensitive core users, we negotiated in with Novogene to set up a blanket PO to offer their “new user” tier of discounted rates to all UTHSC investigators. This contract was approved in Q2 of FY20 (October of 2019). Novogene was selected for this contract since it is one of the

commercial vendors that had absorbed our previously high-volume NGS customers, including Dr. Rob Williams. During FY20-FY21, the MRC advised its clients on the pros and cons of staying in-house or of choosing Novogene's services through the MRC's blanket pricing contract. In FY21, 7 investigators selected to use the Novogene blanket PO for their projects, using MRC as a pass-through entity. In FY22, investigators continued to used the MRC as a pass-through entity to submit samples to Novogene. Under this contract with the MRC, Novogene processed 826 units of samples (units of library preps and flow cells), valued at $83,752.

However, due the receipt of several complaints from UTHSC PIs regarding their NGS quality from Novogene, and the poor customer service offered to our investigators, particularly for custom projects, the Novogene contract was not renewed and it was allowed to lapse on June 30, 2022. At least three investigators who contracted independently with Novogene to quote their project have now approached the MRC to repeat their projects in-house after their projects submitted to Novogene failed due to poor sample handling and back-end customer service.

To address researchers' price sensitivity while seeking to improve customer support for their research projects, we decided 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, 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. Acquisition of the

NextSeq2000 has not only reduced the per the sample pricing for the NGS library preparation kits and the Ilumina flow cells, but will facilitate even quicker turnaround time for our customers based on its expanded sequencing capacity. The largest flow cell for the NextSeq2000 can produce 1.2 billion of paired-end reads, which approximates the output from a 'small scale' flow cell on a NovaSeq platform. Widespread communications highlighting NextSeq2000 services and reduced per sample pricing began in Q2 of FY23 and will be supported by an on-campus visit by Illumina for a seminar on October 27, 2022. This seminar will be recorded and shared with both the UTHSC and UTK campuses.

We also considered the needs of those investigators who require very high sample volume, 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, 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 genomics core on both the UTHSC and the UTK campuses throughout FY23 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, leading in a reduction in revenues for these services from $20,281 in FY21 to $6,270 in FY22.

One factor responsible for this change in volume is that the lead technical staff member who led the arrays services retired from UTHSC in January of 2022, Mr. Lorne Rose. His replacement, Ms. Zoe Brookover, will be trained by Affymetrix to process microarrays at the end of October of 2022. Our microarray profiling business remains useful to researchers as the most cost-effective and method to screen for low abundance differentially-expressed genes as compared to NGS services.

In Q4 of FY20, the Office of Research in conjunction with the MRC made the decision to sunset Sanger sequencing services during Q1 of FY21. Sanger sequencing has been a commodity service available from a wide variety of commercial vendors for almost twenty years. Samples for Sanger sequencing were no longer accepted after September 15, 2021 and all work was completed in-house by September 30, 2021. We maintain a contract with an external vendor (GeneWiz, now Azenta) to offer discounted Sanger sequencing services. This contract also provides discounted services for NGS, although there were no users for the NGS services from Azenta in FY22. In FY22, $10,349 of passthrough invoices for Azenta services (a volume of 2,527 units) were processed by the MRC.

The volume of QiaCube automated nucleic extraction samples remained stable in FY22, with 705 samples processed relative to 648 samples processed in FY21. However, the revenues for real-time PCR services and reagents for the Roche LC480 platform decreased by ~40% in FY22 ($16,785) as compared to FY21 (FY21: $27,749).

Overall, FY22 ended with a net income of $8,972 to be carried forward to FY23. In FY22, the MRC provided 9,106 units of service on behalf of behalf of 71 total investigators (65 internal and 6 external users). The internal users represented 19 departments within four Colleges at UTHSC in Memphis, TN. The six unique external users were located at academic institutions and included Rhodes College, University of Toledo, and University of Memphis. In FY22, the MRC contributed to 193 unique peer-reviewed publications and review articles, and the MRC supported 70 extramural grants, subawards or contracts. The Director, Dr. Taylor, provided >75 consultations to core users and 14 letters of support to 9 independent PIs for a total of 17 grant applications. Dr. Taylor also trained 22 new core users in molecular technologies, primarily new students and postdocs. Twelve tours of the MRC were offered to prospective faculty and new employees.

At the close of FY22, we were offered an opportunity to trade-in our NextSeq500 instrument for a heavily discounted, new NextSeq2000 instrument, which was installed in July of 2022 (FY23). Any additional equipment needs will need to be subsidized directly by the UTHSC campus through matching funds. Equipment needs will be re-evaluated in Q3 and Q4 of FY23 to determine if there are sufficient funds to support additional equipment upgrades or purchases. It is predicted that MRC total recoveries will increase ~10% in FY23 relative to FY22 as the campus continues to recover from the impact of COVID-19 on research progress, and since grants and contract awards continue to increase year over year on the Memphis campus.

There is growing interest in investing in spatial genomics instrumentation on the Memphis campus, which could be managed by the MRC, for example, the GeoMX

digital spatial profiler platform offered by Nanostring. However, in FY23 due to continued budget constraints, there will likely be insufficient local matching funds available, beyond those already allocatied 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 Dr. Steven Goodman, the Vice Chancellor for Research, 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. The UTHSC MRC is one of the few remaining academic core centers in the country that provides microarray services. Microarrays continue to be a high-throughput alternative to NGS, particularly for researchers who are primarily interested in differential gene expression of moderate to highly expressed mRNAs, but not low abundance mRNAS, miRNAs or differential isoforms of the same gene.

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. Although 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 on 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 routinely 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. 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, scaling established protocols to minimize reagent costs and refining techniques, analyses, and processes.

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) professional society for core facilities’ 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 is serving the final year of her five-year term on the board. Dr. Seagroves recently completed service as the SEASR chapter President (June 2021 to June 2022). Dr. Seagroves serves on three sub-committees of the ABRF society, including corporate relations, annual meeting planning, and finance.

Dr. Seagroves also serves 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 advises the VCR on all activities relevant to research and the OSPR committee is charged with developing and executing a 5-year plan to strengthen research on campus. A key component of the OSPR is 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. We are currently in the second year of execution of the new strategic plan (OSPR

v2.0). Supporting core facilities on campus is 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 will be an integral stakeholder in executing the current and any future strategic plans for research.

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 are returning 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, the Senior Associate VCR and/or 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 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 established an active participation 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**:

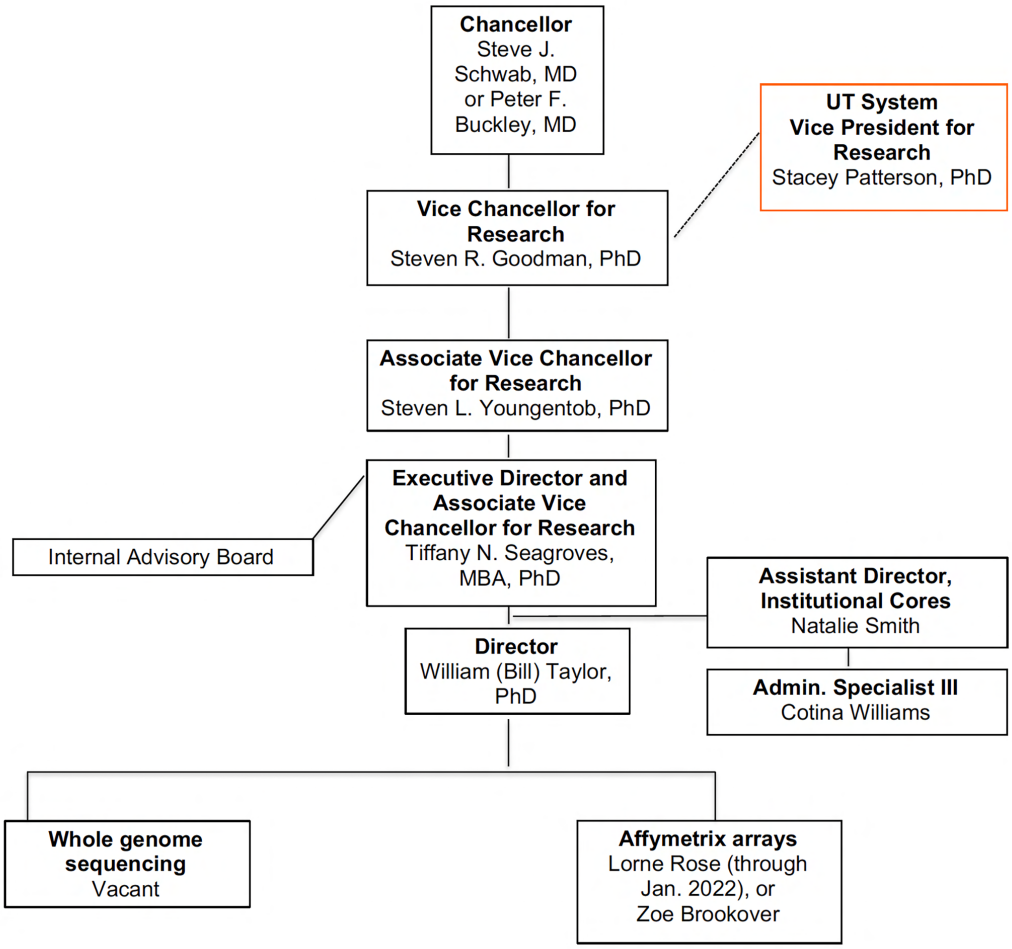
Tiffany N. Seagroves, M.B.A., Ph.D.
Executive Director
Associate Vice Chancellor for Research—Core Laboratories
Professor of Pathology
College of Medicine
University of Tennessee Health Science Center

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

Steven Y. Youngentob, Ph.D.
Senior Associate Vice Chancellor for Research
(retired June of 2022)



FY22 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 Senior Associate Vice Chancellor for Research, Dr. Steven Youngentob, who reports to the Vice Chancellor for Research, Dr. Steven Goodman. Dr. Goodman reported directly to the Chancellor

of UTHSC, Dr. Steve J. Schwab, until Dr. Peter F. Buckley was appointed as Chancellor on February 1, 2022.

The day-to-day operations of the Center in FY22 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 Mr. Lorne Rose, who retired in January of 2022. Ms. Zoe Brookover was recruited to fill this vacant position in February of 2022. 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 Dr. Goodman. 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 Vice Chancellor for Research.

MRC Internal Advisory Board, FY22

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 FY22

Despite the COVID-19 pandemic, all of the UTHSC institutional cores, including the MRC, remained open as essential services throughout FY20-22. The numbers of samples/services processed by the MRC in FY22 remained similar to the volume reported for FY21. Receivables for core services increased by ~22% from $167,408 in FY21 to $204,424 in FY22. The value of all completed work in the MRC in FY22 reported in the iLab database was $203,363, prior to accounting for any receivables for work completed in FY21, but applied to the FY22 budget.

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 and to 9,106 in FY22. During FY22, the MRC served 71 total investigators, of which 65 investigators were internal to UTHSC (92.8% of all investigators), representing the core of our currently extramurally funded investigators, and 6 unique external users, representing three other academic institutions, including two local institutions, Rhodes College and 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 to other UT System campuses to advertise MRC services, including to UT Knoxville (UTK).

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 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 use of the Life Technologies platform has declined. We expect that with the onboarding of the NextSeq2000 mid-to-high throughput instrument in July of 2022 (FY23), we will exclusively recommend the use of Illumina-based services for all NGS projects.

To improve the efficiency and consistency of many operations, the MRC is heavily 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 >100 libraries per week. As of FY18, the Starlet is fully programmed to prepare most NGS libraries on a large-scale, decreasing manual sample manipulation.

The expansion of NGS capabilities in the MRC, along with continued increased interest by investigators, has allowed the MRC to enhance its service delivery components. To educate potential users regarding use of the technology, the MRC continues to sponsor seminars to provide users with a starting point for experimental design. 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 essential to entice researchers “back to the MRC” to meet their NGS needs, as commercial vendors are not as motivated to troubleshoot project issues.

With the expansion of the Molecular Bioinformatics (mBIO) core, an independent institutional core facility located in the same physical footprint at the MRC, we were 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.

Although the gap between price points between micorarrays and NGS continues to narrow, the ease of data analysis between microarray technologies and NGS remains significant for most chemists or biologists, so the MRC continues to provide the microarray services to allow the profiling of global gene expression levels at or near single transcript levels using Affymetrix arrays. Of note, I contrast to microarrays, there are no standardized methods for NGS “runs” or downstream data analysis workflows for research using deidentified, exempt human clinical samples, which is another distinct advantage of using arrays in addition to price. The MRC is one of a few academic core facilities in the US that continues to offer microarray services for gene expression profiling, so it is possible that use of our core by external users may increase over time.

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 had began offering direct shipping to an external sequencing vendor, GeneWiz, 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, increasing to 919 samples in FY21, and to 2,527 in FY22 when no “in-house” options were available. Competitive pricing negotiated with GeneWiz (now named Azenta) for Sanger sequencing remained fixed from FY17-FY21, but increased during FY22 due to general inflation. Based on customer satisfaction, the Azenta contract will be renewed in December of 2022.

Throughout FY18-FY22, the MRC was unable to fill an open Senior Research Assistant position responsible for NGS and other molecular-based services

vacated by Ms. Costelle in FY18. In the interim, Dr. Bill Taylor and Mr. Lorne Rose took over all of the NGS responsibilities, and then Dr. Taylor began training Ms. Brookover. Although the Senior Research Assistant open position still exists, we will not seek to fill it unless sample submissions and recoveries increase in FY23 beyond FY19 levels. Therefore, the decision regarding advertising this open position will likely be deferred until after FY23 closes.

Quantitative real-time PCR assays (qPCR) remain important as discovery and/or validation tools for our researchers. The microarray and qPCR services, previously managed by Mr. Lorne Rose and now managed by Ms. Zoe Brookover, primarily use the Affymetrix platform and the Roche LC480 instruments, respectively. The qPCR operations continue to be in demand, however, the number of real-time polymerase chain reaction (qPCR) samples processed decreased to 185 runs in FY22 from 337 runs in FY21. This decrease is likely because several PIs now house their own benchtop qPCR instruments. Several investigators purchase their qPCR reagents (master mixes and PCR plates) directly from the MRC, which is able to buy reagents in bulk. For example, in FY22, $16,785 was generated from the resale of qPCR reagents, which is notable despite the sharp decrease in the number of qPCR runs completed at the MRC in FY22 using the in-house 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 may use single sign on authentication (via their NetID) to access the iLab web interface to request services, consultations and equipment reservations at all institutional core facilities. 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 now financial integration of iLab with IRIS, such that only active funds may be selected by PIs in advance to request core services.

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 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 form. Prior to iLab, typical errors were the mis-spelling 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 steady user base in the State of Tennessee, the U.S., and abroad. This, in turn is a function of the dedicated and skilled staff as detailed in the organizational chart (Section III. Center of Excellence Overview).

V. Goals and objectives, FY23 (2022-2023)

The goals of the MRC in FY23 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 in the near future. Since large groups are permitted to gather again, the MRC will begin to host vendor seminars on campus. We hosted Nanostring to share information about spatial genotyping in FY22 and we will host Illumina in October of 2022 to highlight the NextSeq2000 instrument. Beginning in Spring of 2023, we hope to begin inviting guest speakers with expertise in genomics and molecular biology again to present 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 new 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 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 been successful in “spreading the word” about the resources available to other researchers in the State. The MRC will continue to assist investigators throughout the State with their projects and project development and will attempt to reach additional investigators throughout the State through direct contact or informational programs. Dr. Seagroves and Dr. Jonathan Phipps, Director of the Core Facilities Program on

the UT-Knoxville campus, met at the 2016 national ABRF meeting and they interact throughout the year to share ideas about core operations and to share information about the availability of core services available on our respective campuses. The overall goal of these interactions will be to increase the awareness of cost-effective services provided by the MRC at UTHSC in Memphis, TN. Ms. Veronica Brown, the UTK Genomics Core director, gave a webinar to our faculty in May of 2022 overviewing the UTK core's services, and she reviewed the onboarding of the NovaSeq6000 instrument for high-volume sequencing projects on the Knoxville campus. In FY23, Dr. Seagroves plans to travel to UTK at Dr. Phipps' invitation to provide an overview of the UTHSC institutional-level core facilities available to Knoxville users, including the MRC.

Participate in execution of the campus v2 Operational Strategic Plan for Research (OSPR). The UTHSC OSPR v2.0 is currently in review by our new Chancellor, Dr. Peter Buckley after approval by our outgoing Chancellor, Dr. Steve Schwab. As previously discussed, as one of the largest Core facilities on campus, the MRC is in unique position to advise members of the OSPR committee of how shared resources can facilitate research progress and new discoveries. Dr. Seagroves chairs the OSPR "Cores" sub-committee. As Chair she attends all OSPR group meetings. When communicating about the "Cores" sub-section of the OSPR, she will interface with Dr. Taylor, the MRC staff, the MRC IAB and key MRC users to craft a plan for how the MRC can support molecular and genomics-based research programs over the next 5 year strategic plan period to support the continued growth of research (2022-2027).

VI. Sample Volume and Financial Summaries

Review of FY22 Sample Volumes and Core Recoveries by Application:

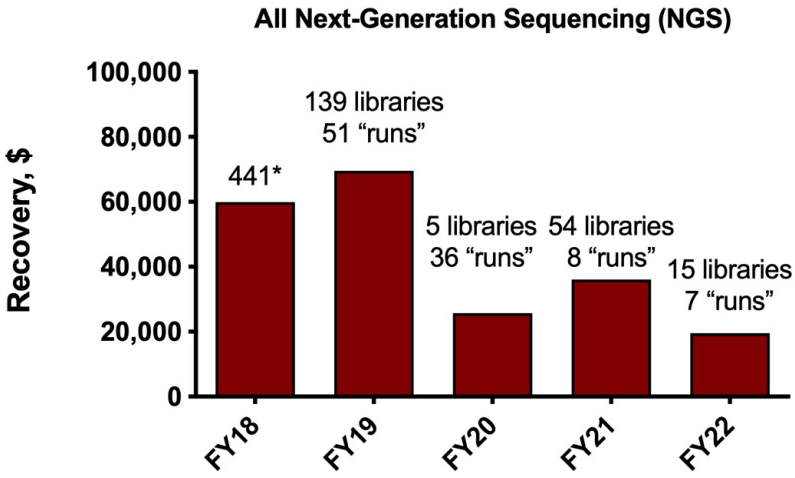


Figure 1: Five-year summary of recovery ($) and total NGS usage (sequencing run + NGS library prep sample numbers= total number of services, as listed above each bar) for the Life Technologies or the Illumina NextSeq500 NGS platforms. The recoveries include services from both NGS platforms (Life Technologies and Illumina), and the usage data includes the total number of library preps plus the number of sequencing "runs". In FY17, library prep accounted for the majority of sample volume, whereas in FY19-FY23, fewer total libraries were prepared, but more high-throughput cartridge "runs" on the Illumina NextSeq were requested.

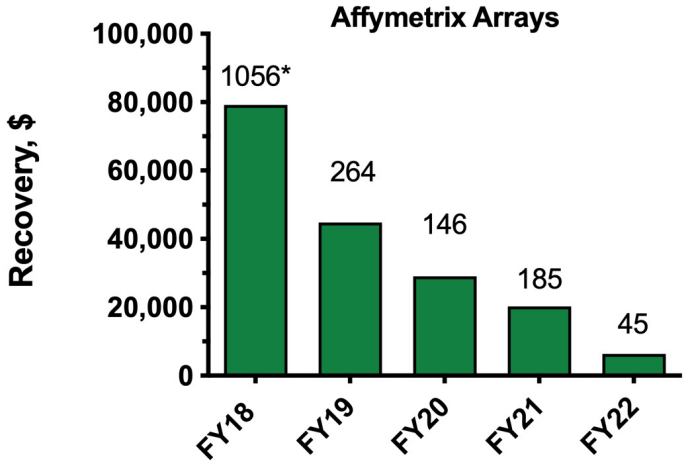


Figure 2: Five-year recovery ($) and usage (number of arrays processed is shown above each bar) for all Affymetrix microarray services. In FY18, array reagents from a bulk purchase that was recognized in FY17 were processed, leading to a higher service volume, but lower overall revenues from services. Revenues from array services decreased in FY19-FY20 due to a preference for NGS profiling, and the impact of the COVID-19 pandemic.

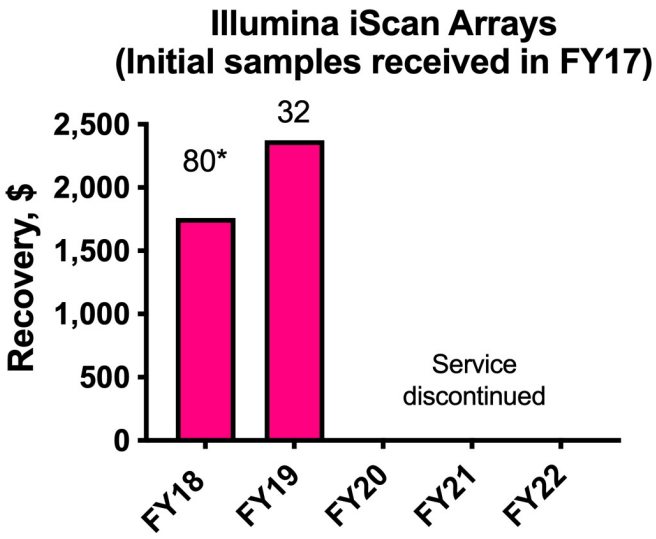


Figure 3: Five-year recovery ($) and usage (number of samples processed on iScan arrays is shown above each bar) for all Illumina iScan microarray services. In FY17, arrays and reagents were purchased from the MRC, but, beginning in FY18, the single investigator who had used the iScan purchased reagents directly from Illumina, and the investigator then paid only the array processing fees to the MRC. All iScan services were discontinued in the MRC in FY20.

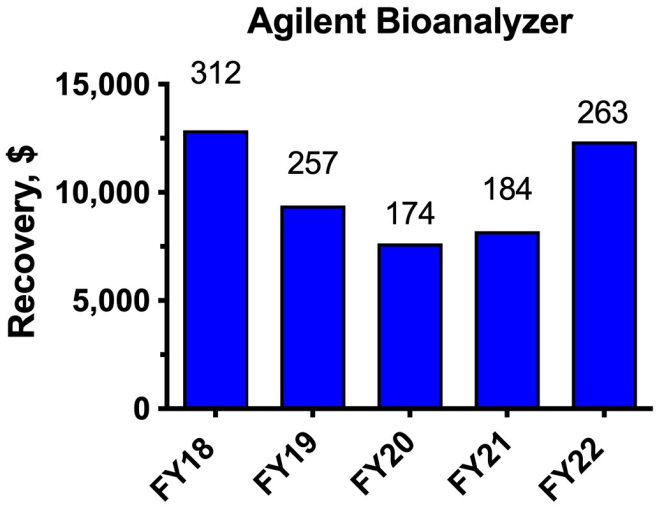


Figure 4: Five-year recovery ($) and usage (number of samples processed is shown above each bar) for the Agilent Bioanalyzer assays, which quantitate DNA and RNA and/or evaluate RNA integrity. These numbers do not include any Bioanalyzer runs that were part of our standard quality control (QC) assessment 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.

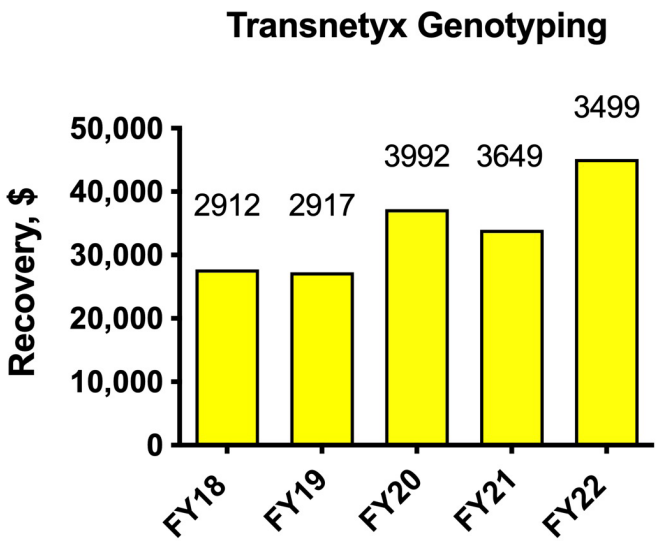


Figure 5: Five-year recovery ($) and usage (the number of samples processed is shown above each bar) for the genotyping service offered through an external genotyping vendor, Transnetyx. Usage remained steady during FY18-FY19, then increased from FY20 to FY22.

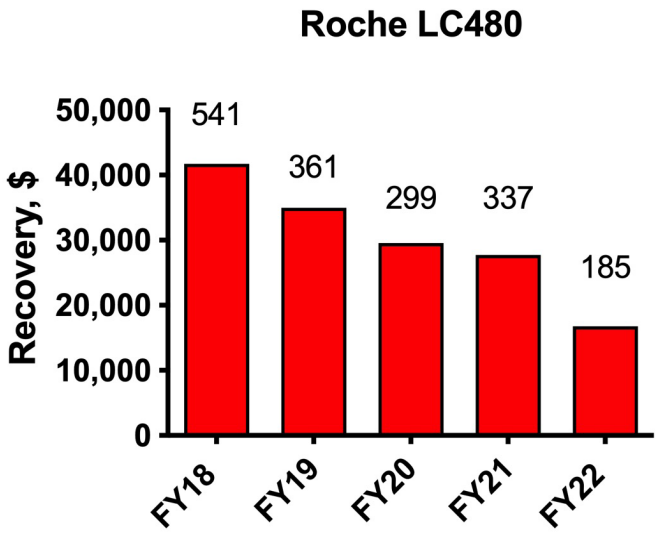


Figure 6: Five-year recovery ($) for all qPCR reagents and Roche LC480 real-time PCR plate “runs” (the number of plate runs is shown above each bar). Instrument use has declined by >60% since FY18 as more investigators purchased their own benchtop qPCR instruments. Concordantly, the volume of qPCR assay supplies and reagents purchased has decreased.

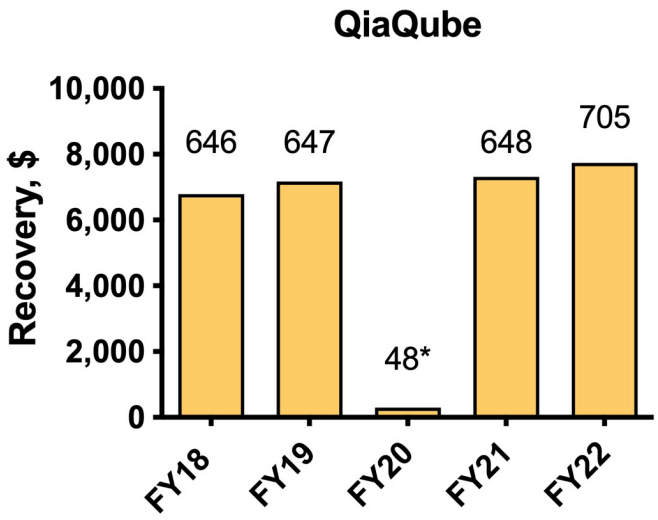


Figure 7: Five-year recovery ($) and usage (number of samples processed is shown above each bar) for the automated preparation of nucleic acids from cells, fluids or pulverized tissues using the Qiagen QiaQube instrument. For enhanced quality control prior to NGS library preparation for RNA-seq, investigators 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 increased in FY22 relative to FY21.

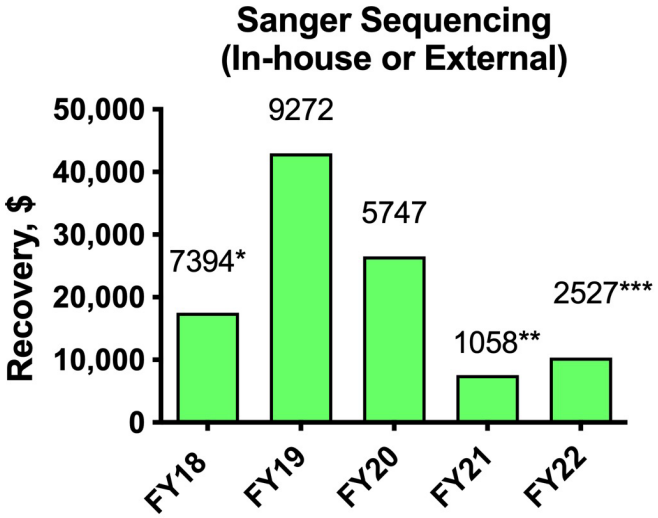


Figure 8: Five-year recovery ($) and usage (number of samples processed is shown above each bar) for Sanger sequencing. Revenues peaked in in FY19 before to decreasing to levels in FY22 that were similar to FY21. Notations: *GeneWiz services ntroduced in FY18 as an option to in-house sequencing. **Sanger sequencing services at the MRC were sunsetted on September 15, 2020; ***data includes only the services offered externally through GeneWiz.

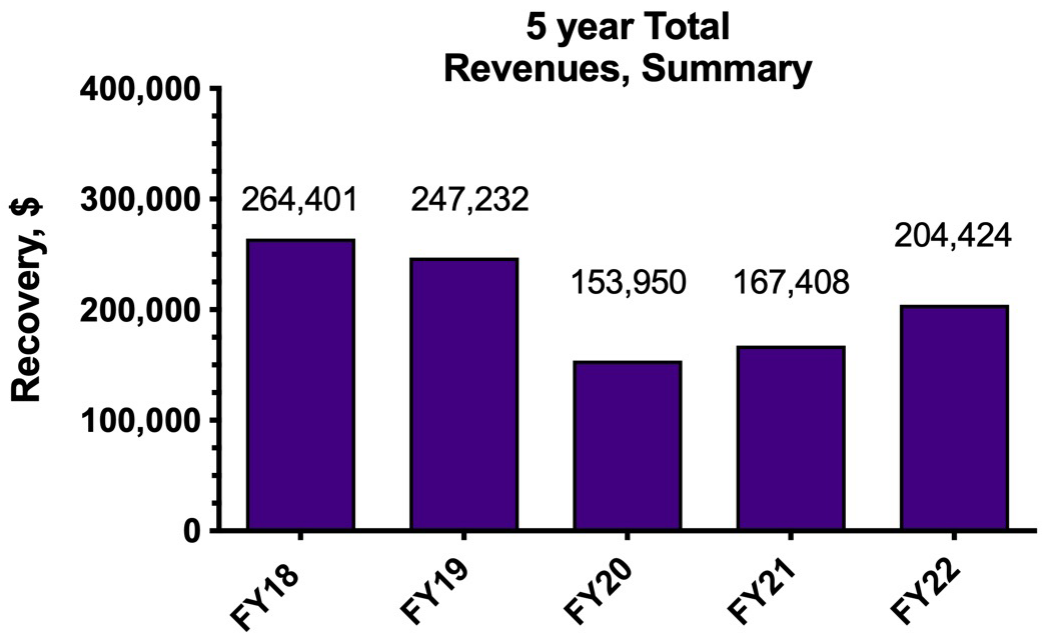


Figure 9: Total recovery ($) for the MRC since FY18. Overall, revenues have decreased since FY18-FY19 as more customers selected commercial vendors for NGS services and the use of microarrays declined. Revenues for FY21 increased ~9% over FY20 levels, and revenues increased ~22% from FY21 to FY22 In FY20-FY21, relative to FY19, total revenues declined since laboratory research was interrupted due to the COVID-19 pandemic.

VII. MRC Assisted Investigators FY21, July 2021-June 2022

Principal Investigator:	Department:	College:
Boughter, John	Anatomy & Neurobiology	Medicine
Chizhikov, Viktor	Anatomy & Neurobiology	
Du, Jianyang	Anatomy & Neurobiology	
Fletcher, Max	Anatomy & Neurobiology	
Heck, Detlef H.	Anatomy & Neurobiology	
Kim, Il Hwan	Anatomy & Neurobiology	
Reiner, Anton	Anatomy & Neurobiology	
Abidi, Ammaar	Biosciences Research	Dentistry
Johnson, Rajasingh	Bioscience Research	
Zhang, Yanhui	Bioscience Research	
Fortwendel, Jarrod	Clinical Pharmacy	Pharmacy
Palmer, Glen	Clinical Pharmacy	
Peters, Brian	Clinical Pharmacy	
Mohamed, Junaith Shai	Diagnostic & Health Sciences	Health Professions
Freeman, Kevin	Genetics, Genomics and Informatics	Medicine
Jones, Byron	Genetics, Genomics and Informatics	
Lu Lu	Genetics, Genomics and Informatics	
Mulligan, Megan	Genetics, Genomics and Informatics	
Simpson, Claire	Genetics, Genomics and Informatics	
Starland-Davenport, Athena	Genetics, Genomics and Informatics	
Williams, Robert W.	Genetics, Genomics and Informatics	
Zhang, Weijing	Genetics, Genomics and Informatics	
Gerling, Ivan	Medicine	Medicine
Gomes-Solecki, Maria	Medicine	
Kovesdy, Csaba	Medicine	
Makowski, Liza	Medicine	
Miranda-Carboni, Gustavo	Medicine	
Narayanan, Ramesh	Medicine	
Quarles, Leigh D.	Medicine	
Fitzpatrick, Elizabeth	Microbiology, Immunology and Biochemistry (MIB)	Medicine
Jonnson, Colleen	MIB	
Li, Kui	MIB	
Radic, Marko	MIB	
Yi, Ae-Kyung	MIB	
Khan, Mohammad	Neurology	Medicine
Reiter, Lawrence	Neurology	
Xiao, Jianfeng	Neurology	

Channappanavar, Rudra	Nursing-Acute&Tertiary	Nursing
Gangaraju, Raja Shekhar	Ophthalmology	Medicine
Jablonski, Monica	Ophthalmology	
Gu, Weikuan	Orthopaedic Surgery	Medicine
Hasty, Karen	Orthopaedic Surgery	
Krum (Miranda), Susan	Orthopaedic Surgery	
Laribee, Ronald	Pathology	Medicine
Pfeffer, Larry	Pathology	
Seagroves, Tiffany	Pathology	
Yue, Junming	Pathology	
Astreinidis, Aristotelis	Pediatrics	Medicine
Bissler, John	Pediatrics	
Brown, Chester	Pediatrics	
Chen, Guoyun	Pediatrics	
Han, Joan	Pediatrics	
Pierre, Joseph	Pediatrics	
Purevjav, Enkhsaikhan	Pediatrics	
Towbin, Jeffrey A.	Pediatrics	
Collier, Daniel	Pharmaceutical Sciences	Pharmacy
Hevener, Kirk	Pharmaceutical Sciences	
Bukiya, Anna	Pharmacology	Medicine
Chen, Hao	Pharmacology	
Dopico, Alex	Pharmacology	
Jee, Chang Hoon	Pharmacology	
Liao, Francesca-Fang	Pharmacology	
Malik, Kafait U.	Pharmacology	
Sakata, Kazuko	Pharmacology	
Tavalin, Steve	Pharmacology	
Always, Stephen	Physical Therapy	Health Professions
Cordero-Morales, Julio	Physiology	Medicine
Jaggar, Jonathan	Physiology	
Kassan, Modar	Physiology	
Mancarella, Salvatore	Physiology	
Rao, R.K.	Physiology	
Tigyi, Gabor	Physiology	
Gosain, Ankush	Surgery	Medicine
Shibata, David	Surgery	
Kuscu, Cem	Transplant Surgery	Medicine

MRC-Assisted External Investigators

Principal Investigator:	Entity:
Fitzgerald, Jonathan	Rhodes College, Memphis, TN
Frawley, Elaine	Rhodes College, Memphis, TN
Huntley, Jason	University of Toledo, Toledo, OH
Lindquester, Gary	Rhodes College, Memphis, TN
Parrill-Baker, Abby	University of Memphis, Memphis, TN
Shen, Qian	Rhodes College, Memphis, TN

VIII. Publications Supported by the MRC in FY22

There were 193 unique publications supported by the MRC in FY22.

1. Ackermann M, Anders HJ, Bilyy R, Bowlin GL, Daniel C, De Lorenzo R, Egeblad M, Henneck T, Hidalgo A, Hoffmann M, Hohberger B, Kanthi Y, Kaplan MJ, Knight JS, Knopf J, Kolaczkowska E, Kubes P, Leppkes M, Mahajan A, Manfredi AA, Maueröder C, Maugeri N, Mitroulis I, Muñoz LE, Narasaraju T, Naschberger E, Neeli I, Ng LG, Radic MZ, Ritis K, Rovere-Querini P, Schapher M, Schauer C, Simon HU, Singh J, Skendros P, Stark K, Stürzl M, van der Vlag J, Vandenabeele P, Vitkov L, von Köckritz-Blickwede M, Yanginlar C, Yousefi S, Zarbock A, Schett G, Herrmann M. Patients with COVID-19: in the dark-NETs of neutrophils. Cell Death Differ. 2021 Nov;28(11):3125-3139. doi: 10.1038/s41418-021-00805-z. Epub 2021 May 24. PMID: 34031543; PMCID: PMC8142290.

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3. Maron BJ, Desai MY, Nishimura RA, Spirito P, Rakowski H, Towbin JA, Dearani JA, Rowin EJ, Maron MS, Sherrid MV. Management of Hypertrophic Cardiomyopathy: JACC State-of-the-Art Review. J Am Coll Cardiol. 2022 Feb 1;79(4):390-414. doi: 10.1016/j.jacc.2021.11.021. PMID: 35086661.

4. Ruilope LM, Pitt B, Anker SD, Rossing P, Kovesdy CP, Pecoits-Filho R, Pergola P, Joseph A, Lage A, Mentenich N, Scheerer MF, Bakris GL. Kidney outcomes with finerenone: An analysis from the FIGARO-DKD study. Nephrol Dial Transplant. 2022 Apr 22:gfac157. doi: 10.1093/ndt/gfac157. Epub ahead of print. PMID: 35451488.

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6. Williams EG, Pfister N, Roy S, Statzer C, Haverty J, Ingels J, Bohl C, Hasan M, Čuklina J, Bühlmann P, Zamboni N, Lu L, Ewald CY, Williams RW, Aebersold R. Multiomic profiling of the liver across diets and age in a diverse mouse population. Cell Syst. 2022 Jan 19;13(1):43-57.e6. doi: 10.1016/j.cels.2021.09.005. Epub 2021 Oct 18. PMID: 34666007; PMCID: PMC8776606.

7. Rizk JG, Lazo JG Jr, Quan D, Gabardi S, Rizk Y, Streja E, Kovesdy CP, Kalantar-Zadeh K. Mechanisms and management of drug-induced hyperkalemia in kidney transplant patients. Rev Endocr Metab Disord. 2021 Dec;22(4):1157-1170. doi: 10.1007/s11154-021-09677-7. Epub 2021 Jul 22. PMID: 34292479.

8. Kovesdy C, Schmedt N, Folkerts K, Bowrin K, Raad H, Batech M, Fried L. Predictors of cardio-kidney complications and treatment failure in patients with chronic kidney disease and type 2 diabetes treated with SGLT2 inhibitors. BMC Med. 2022 Jan 10;20(1):2. doi: 10.1186/s12916-021-02191-2. PMID: 35000594; PMCID: PMC8744296.

9. Conde-Dusman MJ, Dey PN, Elía-Zudaire Ó, Rabaneda LG, García-Lira C, Grand T, Briz V, Velasco ER, Andero R, Niñerola S, Barco A, Paoletti P, Wesseling JF, Gardoni F, Tavalin SJ, Perez-Otaño I. Control of protein synthesis and memory by GluN3A-NMDA receptors through inhibition of GIT1/mTORC1 assembly. Elife. 2021 Nov 17;10:e71575. doi: 10.7554/eLife.71575. PMID: 34787081; PMCID: PMC8598234.

10. Liao FF, Lin G, Chen X, Chen L, Zheng W, Raghow R, Zhou FM, Shih AY, Tan XL. Endothelial Nitric Oxide Synthase-Deficient Mice: A Model of Spontaneous Cerebral Small-Vessel Disease. Am J Pathol. 2021 Nov;191(11):1932-1945. doi: 10.1016/j.ajpath.2021.02.022. Epub 2021 Mar 10. PMID: 33711310; PMCID: PMC8647425.

11. Kovesdy CP. Epidemiology of chronic kidney disease: an update 2022. Kidney Int Suppl (2011). 2022 Apr;12(1):7-11. doi: 10.1016/j.kisu.2021.11.003. Epub 2022 Mar 18. PMID: 35529086; PMCID: PMC9073222.

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17. Perkins RS, Suthon S, Miranda-Carboni GA, Krum SA. WNT5B in cellular signaling pathways. Semin Cell Dev Biol. 2022 May;125:11-16. doi: 10.1016/j.semcdb.2021.09.019. Epub 2021 Oct 9. PMID: 34635443.

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Age-Related Hearing Loss in BXD-Recombinant Inbred Mice. Front Neurosci. 2021 Nov 17;15:745668. doi: 10.3389/fnins.2021.745668. PMID: 34867157; PMCID: PMC8636065.

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IV. GRANTS and CONTRACTS SUPPORTED BY THE MRC in FY22 (70 active awards from July 1, 2021 to June 30, 2022)

Boughter, John

USPHS Grant DC016833, Spatial taste coding in mouse gustatory cortex

Bukiya, Anna

USPHS Grant AA-028380, Fatty acid and alcohol modulation of cerebral artery diameter

Chen, Hao

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

USPHS Grant DA-047638, System genetics of menthol and nicotine addiction

UCSD Subcontract USPHS Grant DA-037844, Integrated GWAS of Complex Behavioral and Gene Expression Traits in Outbred Rats

Chizhikov, Viktor

USPHS Grant NS-093009, Mesenchymal-neuroepithelial interactions in the developing telencephalon.

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

USPHS Grant NS-117873, Spectroscopic analyses of TRPV1 during gating

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

Du, Jianyang

USPHS Grant MH-113986, CO2 inhalation enhances the lability of fear memory.

Fletcher, Max

USPHS Grant DC-013779, Cholinergic modulation of olfactory bulb glomerular sensitivity

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

Army Grant W81XWH-18-1-0477-Freeman, Investigating the downstream oncogenic consequences and therapeutic susceptibilities caused by loss of ARID1A in neuroblastoma

Gomes-Solecki, Maria

University of Iowa Subcontract USPHS Grant AI-39267, Field trial and modeling of transmission-blocking vaccine to prevent Lyme disease

Gosain, Ankush

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

Northwestern Univ Subcontract USPHS Grant HD-099344, Clinical Trial of Enhancing Recovery in Children Undergoing Surgery - ENRICH-US

Gu, Weikuan

Tiantan Hospital Agreement-Gu, Center of Integrating Genomics and Bioinformatics for International Study of Stroke (CIGB-ISS)

Heck, Detlef

USPHS Grant MH-112143, Neuronal mechanisms of cerebellar cognitive function

Sloan Kettering Subcontract USPHS Grant MH-085726, Engrailed genes and cerebellum morphology, spatial gene expression and circuitry Amendment 4

Hevener, Kirk

Army Grant W81XWH2010296 Hevener, 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-137745, Endothelial cell potassium channels

USPHS Grant HL-155180, PKD proteins in endothelial cells

USPHS Grant HL-158846, SK3 channel trafficking 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

Jones, Byron

USPHS Grant ES-031656, Genetics of epigenetic response to high circulating glucocorticoids and organophosphorus compounds

Jonsson, Colleen

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

Kassan, Modar

USPHS Grant Hl-150360, MiR-204 regulates type 1 IP3R/Ca2+ axis to control vascular smooth muscle cell contractility and blood pressure: Potential role of the gut microbiome

Khan, Mohammad Moshahid

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

Kim, Il Hwan

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

Laribee, Ronald

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

Liao, Francesca-Fang

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

Lu, Lu

Binzhou Medical University – Lu, Systems genetics study of hearing loss

Makowski, Liza

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

Mary Kay Foundation – Makowski, PKC agonism reprograms innate immune suppression in TNBC

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, Susan

MRC-Musculoskeletal-Canale Foundation

Kappa Delta Foundation, Kappa Delta Foundation 2021 award

Kappa Delta Foundation, Kappa Delta Foundation 2022 award

Narayanan, Ramesh

USPHS Grant CA229164, Novel Degraders of the Androgen Receptor (AR) and AR Splice Variants (AR-SVs)

Army Grant W81XWH- 21-1-0055 – Narayanan, 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

USPHS Grant AI-152067, Antifungal antagonism as a cause of treatment failure for invasive mycoses

Peters, Brian

USPHS Grant AI-153768, Lipid emulsion composition as a determinant of fungal biofilm formation and incidence of candidemia

Pfeffer, Lawrence M

William & Ella Owens Foundation -Pfeffer, Characterizing a novel STAT3 inhibitor to treat glioblastoma

Pierre, Joseph

USPHS Grant AI-163503, Modeling Host-Fungal Interactions in Hirschsprung-Associated Enterocolitis

Quarles, Leigh Darryl

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

USPHS Grant DK-120567-01, Genetic and Environmental Determinants of GPRC6A Regulation of Energy Metabolism Using Genetically Engineered Mice and Systems Biology.

Rao, Radhakrishna

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

Reiter, Larry

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

Foundation for Prader-Willi Research, Assessment of epigenetic driven circadian rhythm defects in neurons from individuals with PWS

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

Army Grant W81XWH2010019 – Seagroves, 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

Tavalin, Steven J

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

Williams, Robert

USPHS Grant AG-070913, Imaging Genetics of Brain Structure and Cognitive Aging in Murine Models of Alzheimer's Disease

USPHS Grant DA-044223, NIDA Core

Xiao, Jianfeng

USPHS Grant NS-119967, Identification and characterization of the gene associated with the spontaneous autosomal recessive Spinning mice

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: Molecular Res-Ctr of Excellence
R079700143

	FY 2021-22 Actual			FY 2022-23 Proposed			FY 2023-24 Requested		
	Matching	Appropr.	Total	Matching	Appropr.	Total	Matching	Appropr.	Total
Expenditures									
Salaries (Exclude Longevity from Salaries and report separately)									
Faculty			**$0**			**$0**			**$0**
Other Professional	$63,175	$63,175	**$126,350**	$65,070	$65,070	**$130,140**	$67,022	$67,022	**$134,045**
Clerical/ Supporting	$223,393	$223,393	**$446,786**	$230,095	$230,095	**$460,190**	$236,998	$236,998	**$473,995**
Assistantships			**$0**			**$0**			**$0**
Total Salaries	**$286,568**	**$286,568**	**$573,136**	**$295,165**	**$295,165**	**$590,330**	**$304,020**	**$304,020**	**$608,040**
Longevity (Excluded from Salaries)	$6,371	$6,371		$6,562	$6,562		$6,759	$6,759	
Fringe Benefits	$94,371	$94,371	**$188,742**	$97,202	$97,202	**$194,404**	$100,118	$100,118	**$200,236**
Total Personnel	**$387,310**	**$387,310**	**$761,878**	**$398,929**	**$398,929**	**$784,734**	**$410,897**	**$410,897**	**$808,276**
Non-Personnel									
Travel	$1,853	$1,853	**$3,706**	$1,909	$1,909	**$3,818**	$1,965	$1,965	**$3,930**
Software			**$0**			**$0**			**$0**
Books & Journals			**$0**			**$0**			**$0**
Other Supplies	$392,530	$119,614	**$512,144**	$398,600	$123,203	**$521,803**	$385,092	$126,899	**$511,991**
Equipment	$365,032	$66,034	**$431,066**	$375,983	$63,485	**$439,468**	$387,263	$45,094	**$432,357**
Maintenance	$90,365	$59,731	**$150,096**	$93,076	$75,849	**$168,925**	$95,868	$78,124	**$173,993**
Scholarships			**$0**			**$0**			**$0**
Consultants			**$0**			**$0**			**$0**
Renovation			**$0**			**$0**			**$0**
Other (Specify):			**$0**			**$0**			**$0**
Communication	$250	$2,610	**$2,860**	$258	$2,688	**$2,946**	$265	$2,769	**$3,034**
Professional Services & Memberships	$92,302	$92,302	**$184,604**	$95,071	$95,071	**$190,142**	$97,923	$97,923	**$195,846**
Rentals & Insurance		$360	**$360**		$371	**$371**		$382	**$382**
Contractual & Special Services		-$89,068	**-$89,068**		-$41,299	**-$41,299**		-$42,538	**-$42,538**
			$0			**$0**			**$0**
Total Non-Personnel	**$942,332**	**$253,435**	**$1,195,768**	**$964,896**	**$321,276**	**$1,286,173**	**$968,377**	**$310,618**	**$1,278,995**
GRAND TOTAL	**$1,329,642**	**$640,745**	**$1,957,645**	**$1,363,826**	**$720,205**	**$2,070,907**	**$1,379,274**	**$721,515**	**$2,087,270**
Revenue									
New State Appropriation		$664,821	**$664,821**		$687,157	**$687,157**		$721,515	**$721,515**
Carryover State Appropriation		$8,972	**$8,972**		$33,048	**$33,048**		$0	**$0**
New Matching Funds	$1,347,586		**$1,347,586**	$1,440,410		**$1,440,410**	$1,379,274		**$1,379,274**
Carryover from Previous Matching Funds			**$0**	$17,944		**$17,944**	$94,528		**$94,528**
Total Revenue	**$1,347,586**	**$673,793**	**$2,021,379**	**$1,458,354**	**$720,205**	**$2,178,559**	**$1,473,802**	**$721,515**	**$2,195,317**

Molecular Resource Center of Excellence Personnel, FY22 (2021-2022)

Institution:
The University of Tennessee Health Science Center, Memphis, TN

Center:
Molecular Resource Center

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
Lorne Rose*	Senior Research Specialist; Microarrays technician/analyst and NGS assistance
Vacant	Senior Research Assistant; (position vacated April 2017 and reclassified December 2017)
Natalie Smith	Assistant Director (Core Laboratories)
Cotina Williams	Administrative Specialist III

*Mr. Rose retired in January 2022; position was filled by Ms. Zoe Brookover.

Personnel Summary

Appropriated costs for 2021-2022	$387,310
Matching funds for 2021-2022	$387,310
Total costs for 2021-2022	**$774,620**

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

Institution:
The University of Tennessee Health Science Center, Memphis, TN

Center:
Molecular Resource Center

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
Vacant*	Senior Research Assistant
Natalie Smith	Assistant Director (Core Laboratories)

*This vacant position remains unfilled as of October of 2022. Recruitment will be delayed until demand for MRC services and revenues increase.

Personnel Summary

Appropriated funds for 2022-2023	$398,929
Matching funds for 2022-2023	$398,929
Total funds for 2022-2023	**$797,858**

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

Actual 2021-2022 Non-Personnel Total Budget

Travel	$ 1,853
Software	$ 0
Supplies	$ 119,614
Equipment	$ 66,034
Maintenance	$ 59,731
Contract/Special Services	$ (89,068)
Prof Services and Membership	$ 92,302
Communications	$.....2,610
Media	$ 0
Rentals & Insurance	$ 360
Other Expenses	$ 0
Total	**$ 253,435**

Non-Personnel Summary	
Appropriated funds for 2021-2022	$ 253,435
Matching funds for 2018-2019	$ 942,333
Total funds for 2019-2020	**$1,195,768**

Proposed 2022-2023, FY23 Non-Personnel Budget

Travel	$ 1,909
Software	$ 0
Supplies	$ 123,203
Equipment	$ 63,485
Maintenance	$ 75,849
Contract/Special Service	$ (41,299)
Prof Services and Membership	$ 95,071
Communication	$ 2,688
Media	$ 0
Rentals & Insurance	$ 371
Other	$ 0
Total	**$ 321,276**

Non-Personnel Summary, Proposed	
Appropriated funds for 2022-2023	$ 321,276
Matching funds for 2022-2023	$ 964,897
Total funds for 2022-2023	**$ 1,286,173**

Molecular Resource Center of Excellence
Actual Appropriated Funds

Actual 2021-2022 Appropriated Funds and Matching Funds

Total Appropriated Funds 2021-2022	$ 664,821
Carry Over of 2020-2021 funds	$ 8,972
Total Appropriation 2021-2022	$ 673,793
Total Matching funds 2021-2022	$1,347,586
Total Operating Budget, 2021-2022	**$2,021,379**