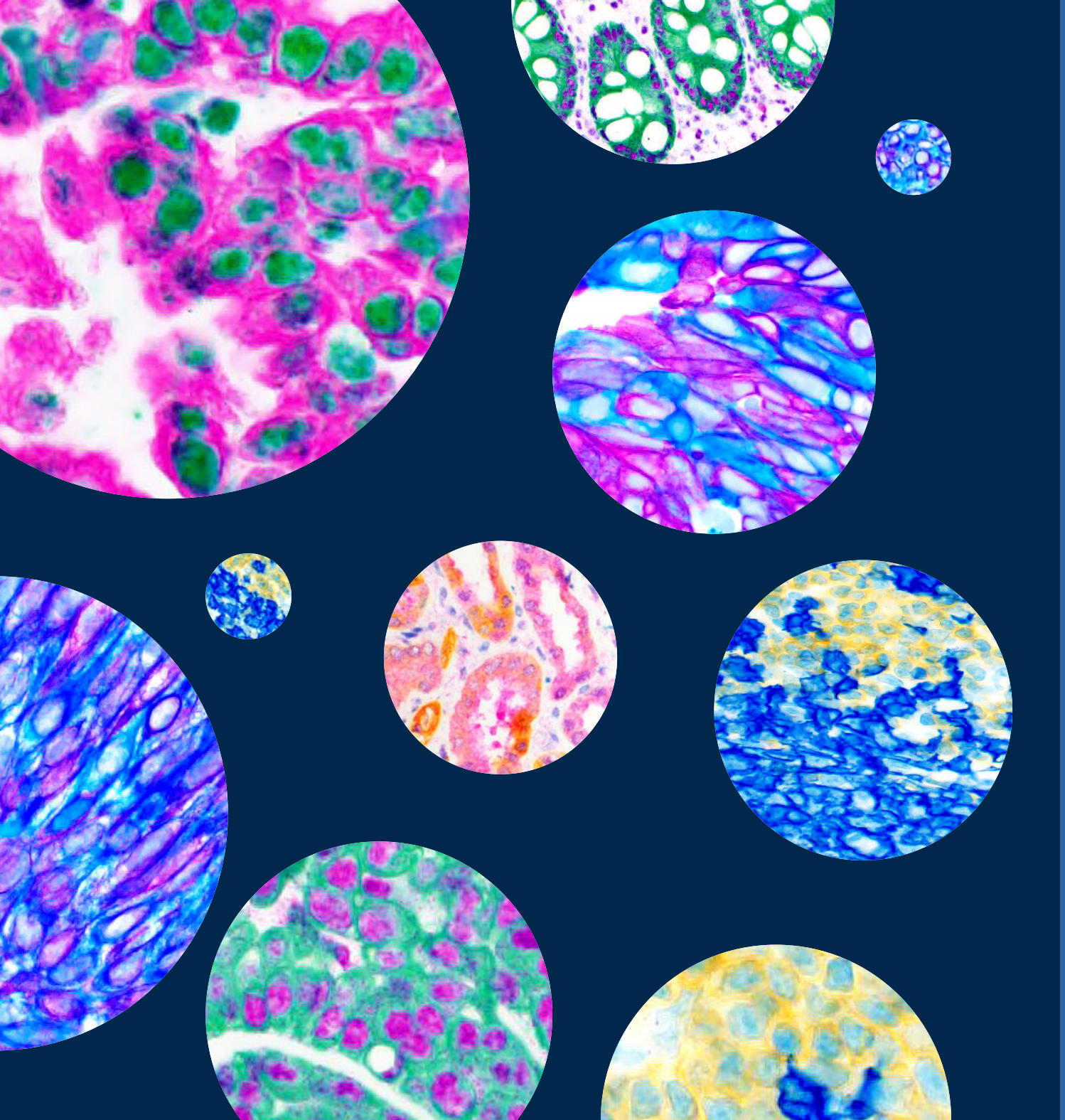

Annual Report 2023

Department of **Pathology**

MICHIGAN MEDICINE
UNIVERSITY OF MICHIGAN

Message From the Chair

This past Fiscal Year (23) was marked by remarkably successful recruitment efforts in the Department of Pathology. In FY23, we brought on-board six new clinical faculty and three new research faculty, and another eleven clinical and three research faculty will be joining us in the first half of FY24.

Also joining the Department in mid-June was Ms. Brooklyn Khoury, MS, MHA, MBA, our new Chief Department Administrator. Brooklyn came to us from Johns Hopkins University where she served as Assistant Administrator for the Department of Genetic Medicine and Johns Hopkins Genomics, which included the Division of Molecular Pathology. Brooklyn began her career as a cytotechnologist in the lab and moved through a variety of laboratory and administrative positions, giving her a well-rounded portfolio of experience and education, ideally suited to filling the role as our new CDA. I want to thank Mr. David Golden for his exceptional leadership and really hard work as our interim CDA over the past two years.

We are excited to announce that Dr. Annette Kim joined us July 1, 2023, as our new Director of the Division of Genetics and Genomics. Dr. Kim was recruited from Brigham and Women's Hospital (BWH) and Harvard Medical School, where she served as Co-Director of the Interpretive Genomics Program and Medical Director of the BH3 Profiling Flow Cytometry Core at the Dana-Farber Cancer Institute. Dr. Kim is a nationally and internationally recognized leader in her field, with a remarkable track record of accomplishment in clinical practice, education, and discovery.

Another successful and major recruitment to join us in mid-FY24 is Dr. Kamren Mirza, a nationally recognized leader in pathology education. He has accepted a position as Assistant Chair of Education and Director of our Division of Education Programs. Dr. Mirza comes from Loyola University where he has served as the Vice Chair of Education and Academic Affairs in the Department of Pathology and Laboratory Medicine. Dr. Mirza's recruitment has generated a buzz of excitement in our department, and we are looking forward to his arrival. Dr. Mirza will be supported by Dr. Sean Li, Director of Pathology Residency Program and Drs. Asma Nusrat and Aaron Udager, who lead our Physician Scientist Training Pathway (PSTP) Program. Under Dr. Li's leadership, our residency program is ranked as the #1 program in the Midwest, #1 program among academic institutions, and #4 overall program nationally according to the Doximity Residency Navigator. Under the leadership of Nusrat and Udager, the PSTP program has seen increased success in recruiting top-notch candidates, graduating their first student in FY23.

In addition to these recruitments, the Department of Pathology is also delighted to introduce two new Division Directors who were promoted internally: Dr. Priya Kunju, Director of the Division of Anatomic Pathology and Dr. Julia Dahl, Director of the Division of Michigan Medicine Laboratories (MLabs). This brings us a total of four new female Division Directors added to our leadership team in FY23. Combined with three new female Assistant Chairs appointed in FY22, our leadership team has added a total of seven extraordinary senior women leaders to our team over the past two years. We are excited about the contributions they have made and will continue to make in our Department.

The Department of Pathology is committed to recruiting the brightest and the best to our faculty and to expanding our research mission. We are actively recruiting for tenure track faculty as we increase our efforts to better understand disease processes and to discover new potential therapies to bring improved health to patients of the future. Our department ranked

3rd in the nation in the number of grants awarded, with more than $31 million in grants funded. Research results generated 348 peer-reviewed publications, many in high-impact journals.

Our clinical laboratories processed 7.3 million billed tests with gross clinical revenues of $1.038 billion in FY23, a 3.7% increase over FY22. The stellar expertise of our clinical faculty was in high demand by external providers resulting in a 5.0% increase in the number of consult cases reviewed in FY23, and our MLabs Division experienced a 10.4% increase in the number of cases accessioned. This growth was possible due to the dedication of our clinical faculty and staff, despite staffing challenges faced.

This year, the Department made significant strides in onboarding digital pathology. Our proposal to move to a fully digitized department was approved by the Medical School, and the hardware and software needed were secured. In FY24, under the leadership of Dr. Mustafa Yousif, we are on track with installing hardware and software, hiring additional staff, conducting training and validation as we prepare to implement digital pathology workflows in an incremental fashion across the department. In addition, our Pathology Informatics faculty and trainees continue to enhance our AI capabilities to aid in slide interpretations. Machine learning algorithms developed are now able to accurately identify multiple pathologic features on digitized slides to facilitate rapid review and diagnosis by pathologists. We continue to press forward in this new frontier in medicine and look forward to new applications of technology facilitating patient care.

Our Molecular Pathology Division continued to expand its services bringing on several new tests and investing in advanced diagnostic equipment for our laboratories. The Michigan Molecular Genetics Laboratory (MMGL) transitioned from Pediatrics to Pathology this year and was merged with Pathology's Molecular Diagnostics Laboratory (MDL) and recently was rebranded as the Division of Diagnostic Genetics and Genomics (DGG). With the arrival of Dr. Annette Kim, we are well positioned to move to the cutting edge on genomic analyses of tumors and germline mutations. This was an exciting year to be part of the Department of Pathology at Michigan Medicine and the coming year holds much promise to be even better.

Charles A. Parkos, MD, PhD

Carl V. Weller Professor and Chair

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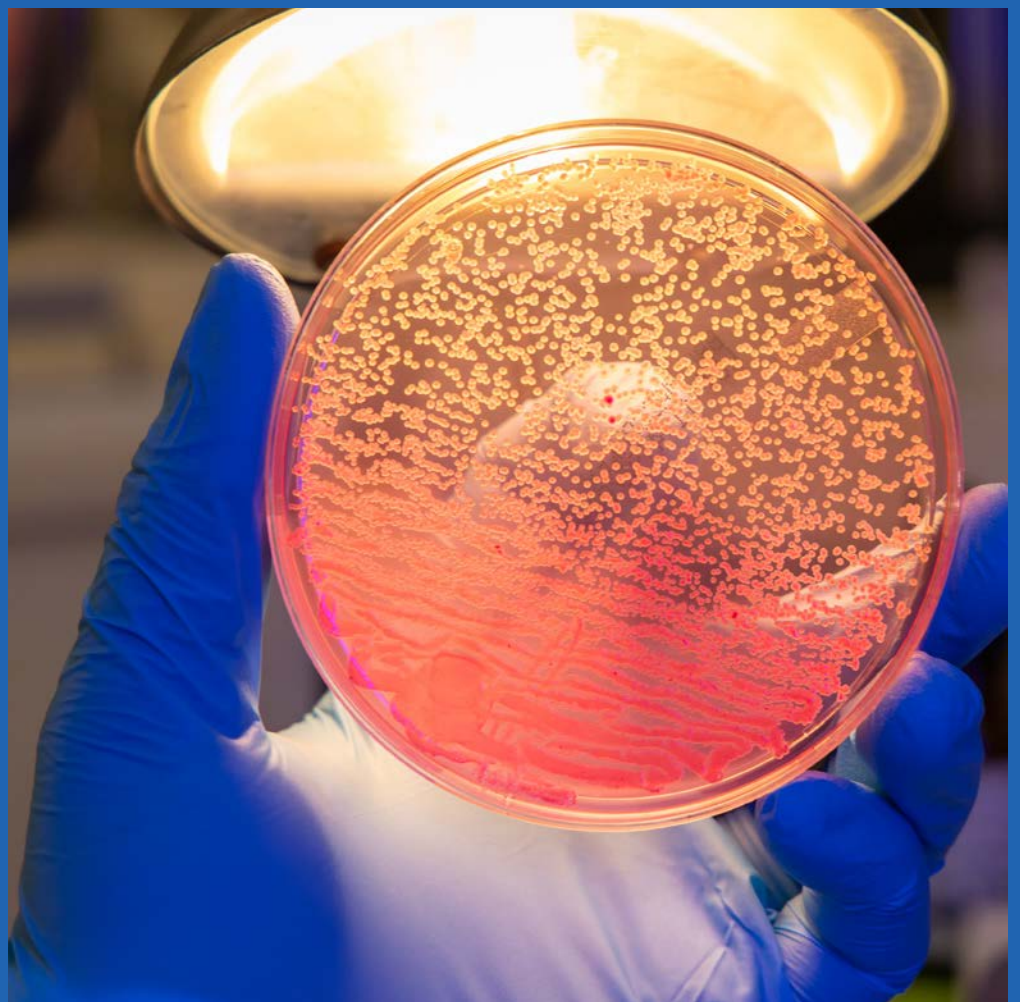
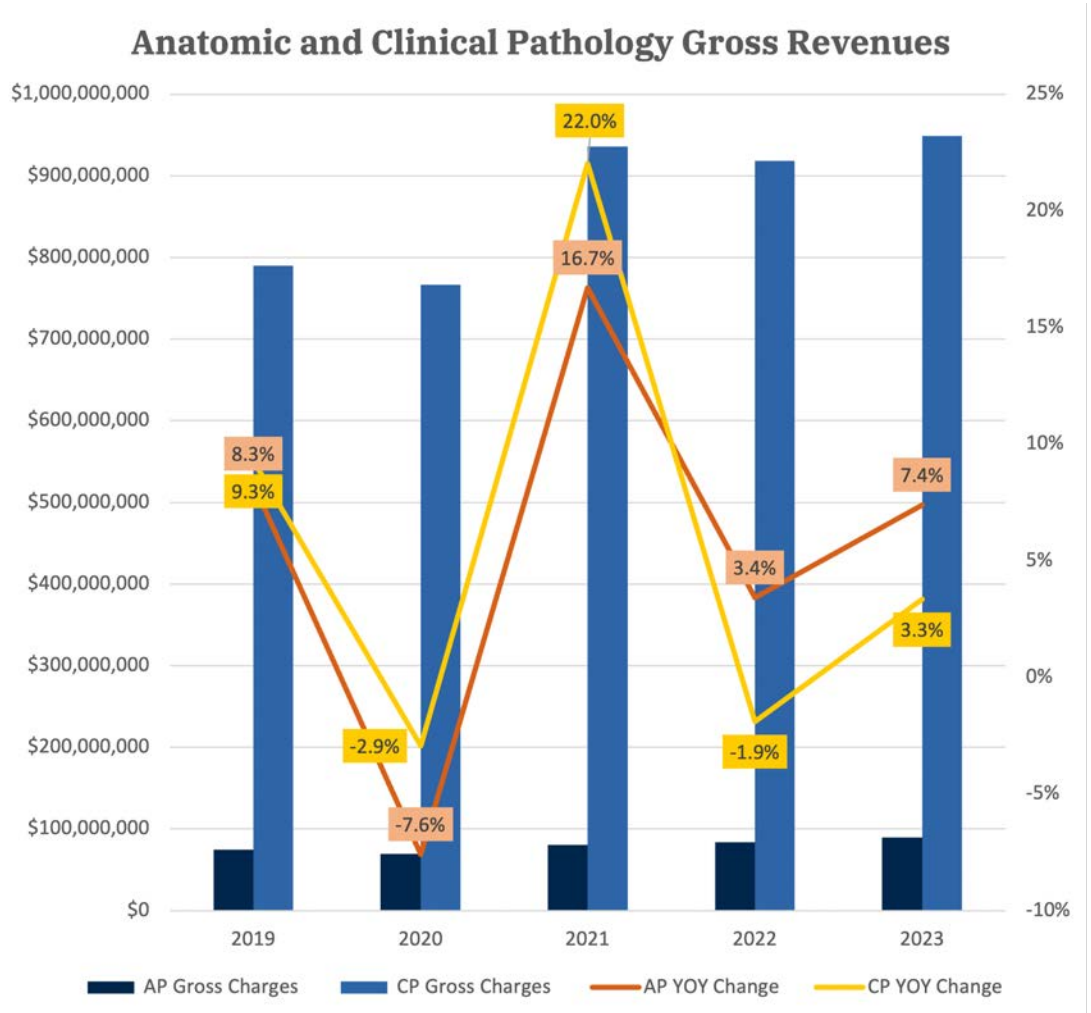


Clinical Mission

The mission of the Department of Pathology is, "to create the future of our discipline by educating and nurturing the leaders and health providers who will care for us, unifying our common commitment to excellence across traditional barriers to collaboration and creativity, building solutions that leverage the power of data to solve real problems and create unique value, and leading the way for application of the right diagnostic tools, for the right patient, at the right time."

To accomplish this mission, our department has three primary foci: Clinical Care, Research, and Education. The clinical mission is committed to providing the best patient care, taking advantage of the strengths of our research and education expertise. To enhance our ability to provide optimal patient care, we built state-of-the-art clinical laboratories at the North Campus Research Complex and are currently renovating space at the University Hospital (UH) for modern core laboratories with automation lines and STAT services.

The clinical laboratory services are divided into four primary divisions: Anatomic Pathology, Clinical Pathology, Molecular Pathology, and Michigan Medicine Laboratories (MLabs). The following pages describe the activities of these four divisions.



By the Numbers

Instructional	49
Clinical	83
Research	36
Supplemental	21

PhD	20
Fellows	18
Post Doc	33
Residents	28

RESEARCH

Annual Expense Budgets	
— Medical School	84 M
— UM Hospital	195 M
Sponsored Spending	31 M
Billable Tests	7.3 M
DC/SF	$358
IDC/SF	$162

RANKED
#7
NIH GRANT FUNDS AWARDED

AWARDS RECEIVED
112

CDA Direct Reports
10

Dotted Line Reports
3

COVID 19

Tests Developed & Validated FY22	
— Diagnostic Tests Performed	131,476
— Serology Tests Performed	438

Anatomic Pathology

L. Priya Kunju, MD
Director, Anatomic Pathology

Stephanie Skala, MD
Section Head, Surgical Pathology

David Lucas, MD
Service Director, Bone and Soft Tissue Pathology

Anatomic Pathology (AP) deals with testing of tissues, solid tumors, and cells as well as autopsies and forensics. AP experienced an increase in volume of 0.7% from a total of 155,107 cases from FY22 to 156,156 cases in FY23 as volumes stabilized following the COVID-19 pandemic. The AP clinical service is comprised of several sections including Surgical Pathology, Cytopathology, Dermatopathology, Ophthalmic Pathology, Renal Pathology, Neuropathology, Autopsy and Forensic Pathology, and Pediatric/Perinatal Pathology, each with its own section head. Surgical pathology includes multiple subspecialty services each with a designated service chief. Most of these services support weekly multidisciplinary tumor boards.

Clinical Activities

RVU Trends in Anatomic Pathology

Total RVUs generated by AP in FY23 expressed as a 12-month rolling average were 23,648 RVUs/month. This represents a 4.2% increase over FY22 and reflects a steady recovery from the COVID-19 pandemic. RVU stands for relative value unit and is an incomplete payer-imposed measure of professional work that has become an industry standard for monitoring clinical productivity.

FTE Trends in Anatomic Pathology

Total clinical FTEs for AP faculty was 55.1 in FY23 compared to 53.0 in FY22, representing 4.0% year-over-year increase. Over a five-year period, AP staffing has similarly increased by 33.4% from 41.3 FTEs to 55.1 FTEs due to hiring new faculty members each year to meet the demands of our constantly growing AP service workload and complexity. This included employing faculty with dual fellowships and hybrid skill sets in an AP subspeciality paired with molecular pathology, as well as hiring two new AP Hospitalists to primarily cover hospital-based services such as frozen sections.

RVU and FTE Trends in Anatomic Pathology

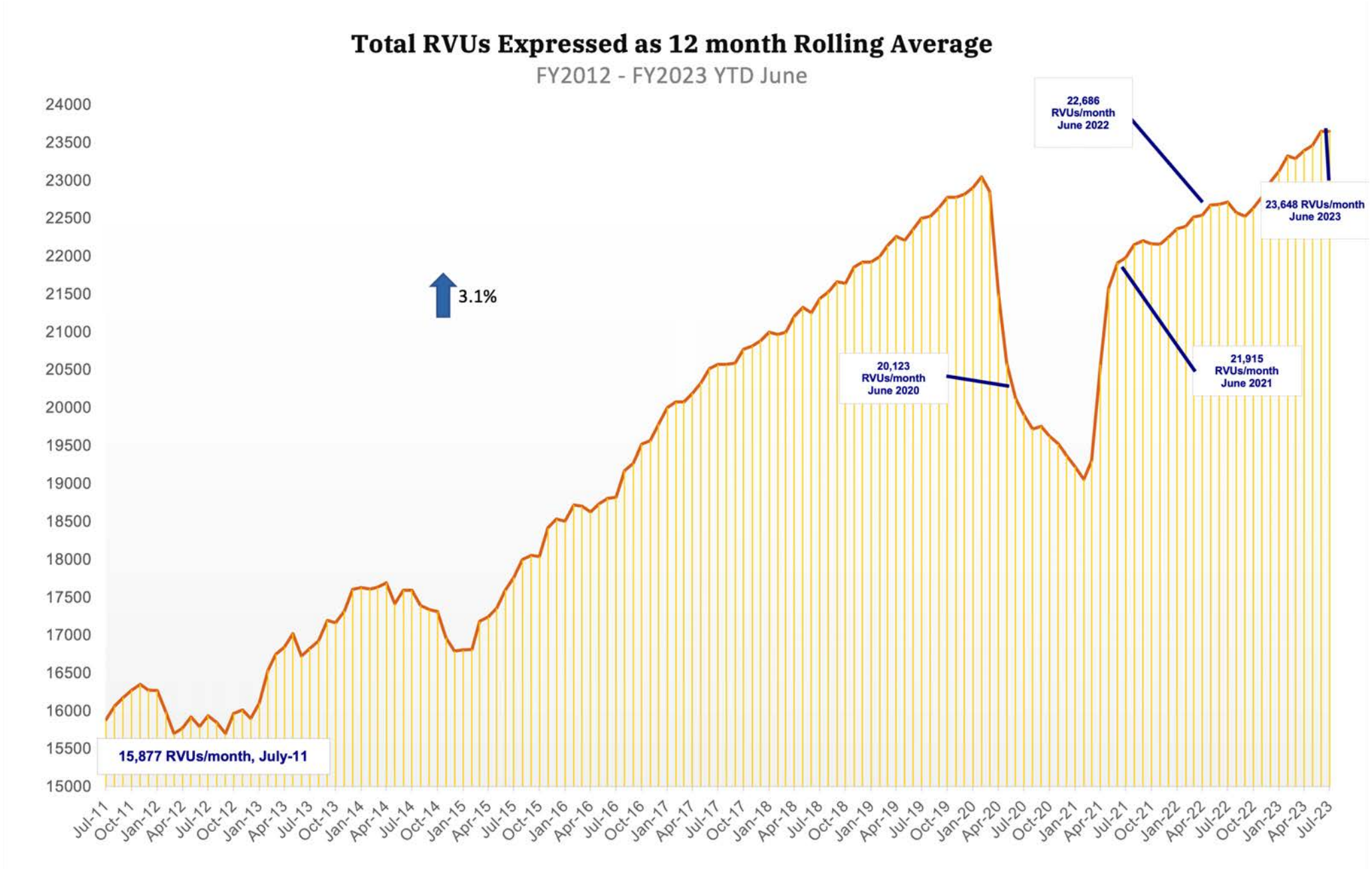
Total work RVUs/FTE in FY23 showed a 5.7% increase. On average, each clinical FTE in AP generated 685.4 RVUs/month in FY23 compared to 706.7 in FY22. However, these data vary for different AP services and from month to month due to faculty hiring throughout the year. *(See Table on pg. 11)*

Surgical Pathology

The Surgical Pathology section encompasses a general sign-out service and multiple subspecialty services, each with its own service chief. The clinical service provided by surgical pathology faculty includes frozen section coverage at University Hospital (UH), adult surgeries at C.S. Mott Children's and Von Voigtlander Women's Hospital, Frankel Cardiovascular Center, East Ann Arbor Medical Center, and Brighton Center for Subspecialty Care. Telepathology continued to be leveraged to remotely support our frozen section service. General Surgical Pathology (also known as "Room 1") service handles biopsies and surgical resection specimens not covered by other subspecialty areas. In FY23, 12,480 general specimens were processed, which represents a decrease of 0.1% from the prior year. Likewise, this service has experienced a 10.7% overall decrease when compared to specimen volumes from five years ago.

Bone and Soft Tissue Pathology

Bone and Soft Tissue Pathology is focused on the diagnosis and study of diseases of the bone and surrounding soft tissues. Bone & Soft Tissue consult cases, which include very challenging, unique, and rare lesions, increased by 15.3% with 2,110 cases received in FY23. This consult service has shown an overall 29.5% increase compared to specimen volumes from five years ago.


Total RVUs Expressed as 12 month Rolling Average
FY2012 - FY2023 YTD June
24000
23500
23000
22500
22000
21500
21000
20500
20000
19500
19000
18500
18000
17500
17000
16500
16000
15500
15000
22,686 RVUs/month June 2022
23,648 RVUs/month June 2023
3.1%
20,123 RVUs/month June 2020
21,915 RVUs/month June 2021
15,877 RVUs/month, July-11
Jul-11
Oct-11
Jan-12
Apr-12
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Oct-12
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Rouba Ali-Fehmi, MD
Service Director, Breast Pathology

Thomas Giordano, MD, PhD
Service Director, Endocrine Pathology

Laura Lamps, MD
Service Director, Gastrointestinal / Hepatobiliary Pathology

L. Priya Kunju, MD
Service Director, Genitourinary Pathology

Kathleen Cho, MD
Service Director, Gynecologic Pathology

Jonathan McHugh, MD
Service Director, Head and Neck / Oral-Maxillofacial Pathology

Breast Pathology

Breast Pathology is a subspecialty of surgical pathology with expertise in the interpretation of breast lesions from various specimen types including needle core biopsy, lumpectomy, and mastectomy specimens. Our Breast Pathology service includes a unique dedicated frozen section laboratory for margin assessment and intraoperative consultation. The Breast Pathology division also features a consultation service that assists with diagnostically challenging cases. In FY23, the Breast Pathology service processed 3,970 cases which represents a 11.1% growth compared to FY22 and 35.6% growth compared to five years ago.

Endocrine Pathology

Endocrine Pathology is the study of diseases of the endocrine system including the thyroid, parathyroid, pituitary gland, endocrine pancreas, and adrenal glands. This service completed 788 challenging consult cases in FY23, which is a 20.3% increase from FY22 and represents a 28.6% increase compared to specimen volumes from five years ago.

Gastrointestinal/Hepatobiliary Pathology

Gastrointestinal Pathology (GI) is a subspecialty of surgical pathology that deals with the diagnosis and characterization of neoplastic and non-neoplastic diseases of the digestive tract and accessory organs such as the pancreas, gallbladder, and liver. The Gastrointestinal/Hepatobiliary service completed 22,305 in-house cases in FY23, an increase of 1.4% as compared to FY22. Case numbers show a 5.9% decrease compared to five years ago.

Genitourinary Pathology

Genitourinary Pathology (GU) is a subspecialty of surgical pathology that deals with the diagnosis and characterization of neoplastic and non-neoplastic diseases of the urinary tract, excluding medical disorders of the kidneys, which fall under renal pathology. This includes diseases of the male genital tract and testes. The GU service processed 3,333 cases in FY23, which was up 3.5% from the prior year. Overall, GU specimen volumes are down 16.1% compared to specimen volumes from five years ago. The decrease of in-house GU specimens is partially due to Michigan Medicine urologists frequently operating at Chelsea Hospital (owned by Michigan Medicine), but pathology evaluation of these GU cases is performed at Trinity Health by contract. This service also completed 2,346 extramural consultations (transfer and private consults) in FY23, which is a 4.2% increase from FY22 and represents a 9.2% increase compared to volumes from five years ago.

Gynecologic Pathology

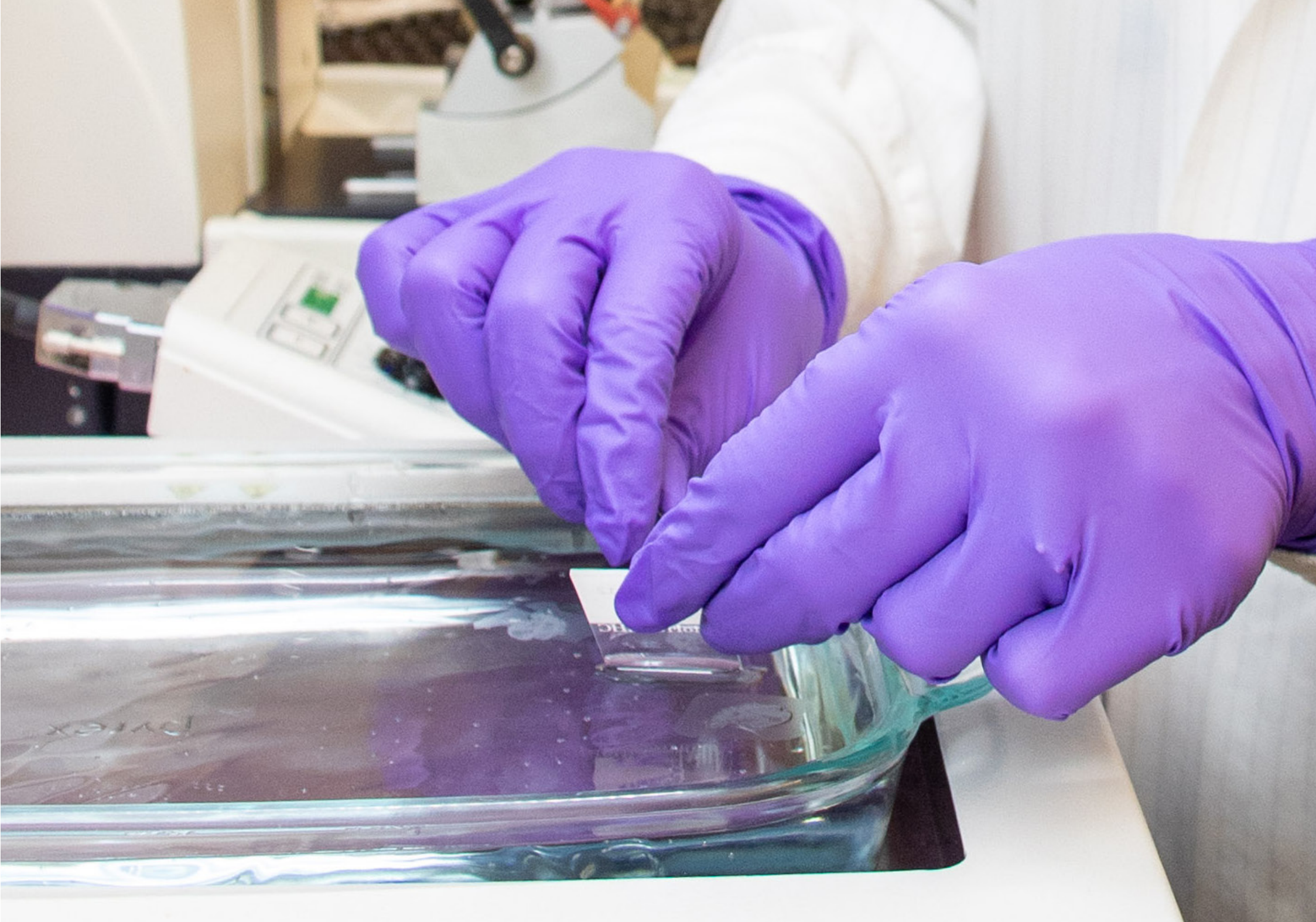
Gynecologic Pathology (GYN) is the subspecialty that deals with the study and diagnosis of disease involving the female genital tract. The GYN service processed 7,620 cases in FY23, which is a 1.0% decrease from the prior year. This represents a 1.5% decrease compared to specimen volumes from five years ago.

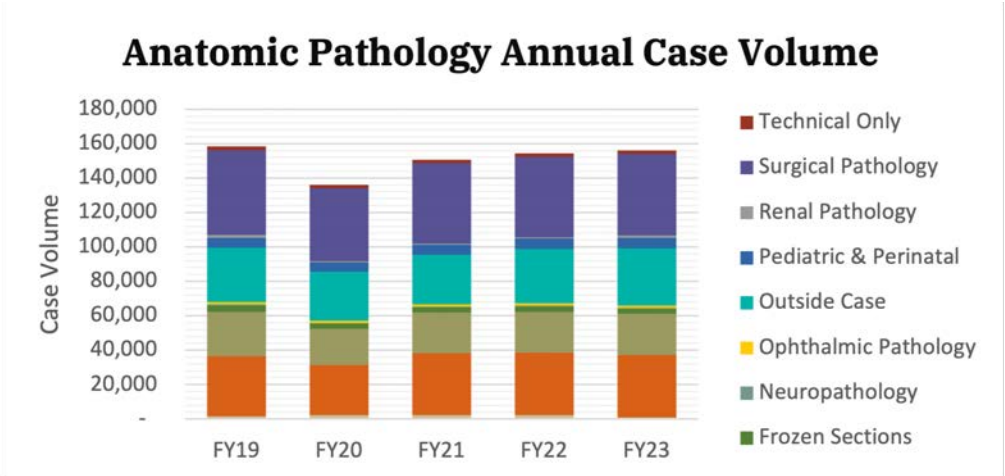
Head and Neck Pathology/Oral-Maxillofacial Pathology

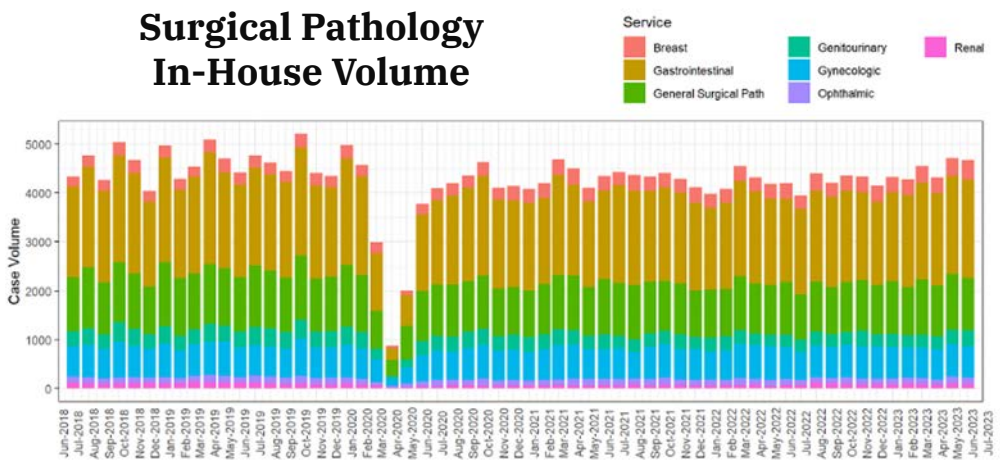
Head and Neck Pathology covers neoplastic diseases of the thyroid gland, salivary glands, and head and neck. Oral-Maxillofacial Pathology is concerned with the diagnosis and study of diseases affecting the oral and maxillofacial region and is sometimes considered to be a specialty of dentistry and pathology. Internally generated head and neck cases were included in the general Surgical Pathology service described above. Consult cases are handled by our head and neck service and amounted to 1,552 cases in FY23, which was a 10.6% increase over FY22 and represents a 13.6% increase compared to specimen volumes from five years ago.

Pulmonary/Thoracic Pathology

Pulmonary Pathology is a subspecialty of surgical pathology that deals with the diagnosis and characterization of neoplastic and nonneoplastic diseases of the lungs, pleura, and mediastinum. In-house cases are not tracked separately from other Surgical Pathology cases. However, the Pulmonary Pathology service evaluated 2,960 complex consultation cases, no change as compared to FY22, and a 7.0% decrease compared to specimen volumes from five years ago.







Annual Case Volumes

AP Service	FY19	FY20	FY21	FY22	FY23	1-YR	5-YR
Autopsy & Forensics	1,636	2,315	2,325	2,191	889	-56.00%	-45.66%
Cardiovascular	166	215	445	554	986	97.08%	493.98%
Cytopathology	34,835	28,737	35,305	35,942	35,392	-1.56%	1.60%
Dermatopathology	25,720	21,017	23,707	23,676	23,897	0.93%	-7.09%
Frozen Sections	3,620	3,162	3,073	2,876	2,856	-0.65%	-21.10%
Neuropathology	556	493	543	591	569	-4.05%	2.34%
Ophthalmic Pathology	1,424	1,353	1,384	1,453	1,445	-0.58%	1.47%
Outside Case	31,471	28,337	28,664	31,593	33,201	5.61%	5.50%
Pediatric & Perinatal	5,973	5,297	5,645	5,890	6,172	5.00%	3.33%
Renal Pathology	1,413	943	811	859	1,171	38.47%	-17.13%
Surgical Pathology	49,294	42,082	46,701	46,549	47,348	1.71%	-3.95%
Technical Only	2,165	2,133	2,119	2,215	2,092	-5.80%	-3.37%
TOTAL	**158,273**	**136,084**	**150,722**	**154,389**	**156,018**	**1.08%**	**-1.42%**

Outside Case Volumes

AP Service	FY19	FY20	FY21	FY22	FY23	1-YR	5-YR
Breast	1,737	1,541	1,509	1,768	1,912	8.1%	10.1%
Cardiac	20	21	24	15	39	160.0%	95.0%
Cytology	1,196	1,192	1,076	1,223	1,192	-2.5%	-0.3%
Dermatopathology	7,400	6,518	6,382	6,761	6,421	-5.0%	-13.2%
Endocrinology	613	551	539	655	788	20.3%	28.5%
Gastrointestinal	5,220	5,043	5,108	5,548	5,873	5.9%	12.5%
Genitourinary	2,148	1,959	1,845	2,252	2,346	4.2%	9.2%
Gynecologic	1,696	1,571	1,520	1,735	1,914	10.3%	12.9%
Head & Neck	1,366	1,255	1,303	1,403	1,552	10.6%	13.6%
Hematopathology	2,707	2,347	2,400	2,713	2,782	2.5%	2.8%
InterDepartmental Consult	635	356	608	296	394	33.1%	-38.0%
Misc Outside Case	22	9	6	1	5	400.0%	-77.3%
Muscle	33	29	22	34	25	-26.5%	-24.2%
Neuropathology	522	597	879	1,146	1,536	34.0%	194.3%
Ophthalmic	52	73	75	83	92	10.8%	76.9%
Pediatric	477	407	408	456	445	-2.4%	-6.7%
Pulmonary	3,184	2,712	2,564	2,962	2,960	-0.1%	-7.0%
Renal	59	43	34	52	86	65.4%	45.8%
Soft Tissue	1,630	1,481	1,696	1,830	2,110	15.3%	29.4%
Total	**30,717**	**27,705**	**27,998**	**30,933**	**32,472**	**5.0%**	**5.7%**

Jeffrey Myers, MD
Service Director, Pulmonary/ Thoracic Pathology

David Gordon, MD
Service Director, Cardiovascular Pathology

Raja Rabah, MD
Section Head, Pediatric and Perinatal Pathology

May Chan, MD
Section Head, Dermatopathology

Case Volume—all Surgical Pathology services in FY23 includes all in-house specimens and extramural consultations (transfer and private consults). This case volume for Surgical Pathology was 52,291, which represents a varied year-over-year change for different subspecialties, with an overall 2.0% increase from the prior year.

Frozen Sections—case volume for FY23 was 2,856, representing a decrease of 0.7% compared to FY22.

Surgical Pathology In-house Turnaround Time—defined from when a specimen is received in pathology until the case is signed out, overall increased an average of 2.0% compared to one year ago. This turnaround time is 5.2% faster compared to 5 years ago. This can be attributed to several measures including leveraging informatics for better tracking of turnaround time and delayed cases, as well as immediate notification of faculty about late cases.

Cardiovascular Pathology

Cardiovascular Pathology examines the heart and major blood vessels to determine the diseases of these organs, whether congenital or acquired in life. Cases include surgical specimens from living patients or autopsy specimens from deceased patients as well as heart biopsies. A formal cardiovascular pathology service was created in February 2022 in Anatomic Pathology.

Case Volume—The cardiovascular surgical pathology case volume of 989 for FY23 reflects a 78.2% increase compared to the previous year.

Turnaround Time—Average turnaround time for cardiovascular surgical pathology cases was 2.7 days in FY23, which decreased by 3.8% in the last year.

Pediatric and Perinatal Pathology

This medical subspecialty is focused on childhood diseases as well as perinatal conditions affecting the placenta and fetus. The work includes pediatric surgical pathology cases as well as autopsies and placental examinations.

Case Volume—The pediatric surgical pathology case volume of 6,745 for FY23 reflects a 3.7% increase compared to FY22 and a 1.8% increase compared to specimen volumes from five years ago. Placental exams decreased by 3.9% to 2,066 cases in FY23 and showed a 3.8% decrease over five years. Pediatric fetal exams decreased 6.6% from FY22 with 240 cases performed, where pediatric autopsies had 23 cases, which is a 17.9% decrease from FY22.

Turnaround Time—Average turnaround time for pediatric surgical pathology cases was 2.3 days in FY23, which decreased by 1.3% in the last year. These turnaround times also demonstrate that cases in FY23 were signed out 6.6% faster compared to five years ago.

Dermatopathology

Dermatopathology focuses on the study of cutaneous diseases at a microscopic and molecular level. The dermatopathology service utilizes light microscopy, immunofluorescence, and molecular testing.

Case Volume—The Dermatopathology service experienced an overall 0.4% decrease in FY23 and handled a total of 30,319 cases. This included a 3.8% increase in specimens from Michigan Medicine patients (“in house” cases) which accounted for 51.5% of the cases seen. Cases from patients outside of Michigan Medicine (“MLabs cases”) were down 4.1% in FY23.

Turnaround Time—Overall turnaround time for dermatopathology cases averaged 4.2 days, showing on average 16.4% increase over FY22.

Neuropathology

Neuropathology is that branch of pathology that focuses on the diagnosis of diseases of the central and peripheral nervous systems and incorporates non-neoplastic conditions targeting skeletal muscle.

Case Volume—For FY23, there were a total of 2,618 cases signed out compared to 2,218 cases in FY22, representing a 18.1% increase. Over a five-year period, this service has witnessed a 52.6% increase in neuropathology cases including a 34% in consult cases.

Turnaround Time—Cases decreased on average to 4.8 days, showing an 8.5% improvement from FY22 and a 16.6% improvement compared to five years ago.

Ophthalmic Pathology

Ophthalmic Pathology focuses on diseases of the eye and unique periorbital structures. These cases are predominantly signed out at the W.K. Kellogg Eye Center in Ann Arbor.

Case Volume—This service accounted for 1,543 cases in FY23, stable as compared to the prior year and a 2.4% increase over the past five years.

Turnaround Time—Averaged 4.2 days showing an increase of 14.6% in FY23 and a 57.0% improvement over five years.

Renal Pathology

The Renal Pathology service focuses on the diagnosis and characterization of medical diseases (non-tumor) of the kidneys.

Case Volume—Medical renal biopsy case volume increased to 1,258 in FY23, representing 38.1% increase and 14.5% decrease in one-and five-year-over-year changes, respectively. The FY23 increase was driven in part by changes in transplantation surveillance biopsy practices related to COVID-19 in the prior year.

Turnaround Time—For medical renal biopsies the overall turnaround time was 8.1 days in FY23, representing an increase of 34.1% compared to last year, but a 95.9% decrease compared to five years ago.

Cytopathology

Cytopathology is a branch of pathology that performs diagnostic testing on samples consisting of mostly individual cells, such as Pap tests, body fluids, brushings, and fine needle aspirations (FNA). Our cytopathologists perform rapid on-site evaluations (ROSE) at multiple clinics and procedure rooms throughout Michigan Medicine. Telecytology is frequently employed to support this service. ROSE enables rapid specimen triage and diagnostics for patients while they are still at the medical center, eliminating the need for follow-up visits due to inadequate sampling. Our cytopathology team are also skilled at performing palpation-guided and ultrasound-guided FNA themselves.

Case Volume—Our cytopathology service processed 35,392 cases in FY23 which was down 1.5% from FY22 and up 1.6% compared to five years ago. Gynecologic Pap tests represented the bulk of these cytopathology cases. There were 8,202 non-gynecologic cytopathology cases in FY23 in addition to 3,375 FNAs, which included percutaneous and endoscopic aspirations.

Turnaround Time—The average turnaround time for all cytology cases was 1.6 days in FY23, which is approximately a 3% decrease from previous years.

Autopsy and Forensic Pathology

Hospital and forensic autopsies and examinations represent major activities within Anatomic Pathology. Our fellowship-trained forensic pathologists handle forensic cases from Washtenaw and Livingston Counties. All Michigan Medicine adult and pediatric autopsies as well as all forensic cases from Washtenaw and Livingston Counties are performed in the University Hospital (UH) morgue. Wayne and Monroe County forensic cases, performed at the Wayne County Medical Examiner's Office, were discontinued in FY22, which will account for overall decreases in the number of autopsies and exams.

Case Volume —Autopsies performed in the UH morgue were down 10.7% from FY22 and showed an 12.0% decrease over the past five years. Case volumes of autopsies performed at the Wayne County Medical Examiner's Office were discontinued in FY22.

Turnaround Time—Demonstrated an average of 56.4 days to finalize an autopsy, representing a 13.8% overall increase compared to last year, and 29.6% increase compared to FY19.

Consultation Service

Our extramural consultation practice is an important component of our practice. The rare and difficult cases encountered with this service challenge our faculty to continue to deepen their expertise and expose our trainees to cases otherwise rarely seen.

Andrew Lieberman, MD, PhD
Section Head, Neuropathology

Victor Elner, MD, PhD
Section Head, Ophthalmic Pathology

Evan Farkash, MD, PhD
Section Head, Renal Pathology

Judy Pang, MD
Section Head, Cytopathology

Allecia M. Wilson, MD
Section Head, Autopsy & Forensic Pathology

Autopsy and Forensic Services FY23

	FY18	FY19	FY20	FY21	FY22	FY23
Wayne County	3,272	3,183	3,007	3,463	3,626	-
Washtenaw/Livingston County	483	521	560	647	588	560
Michigan Medicine	189	194	188	151	142	131

Case Volume / UH, Washtenaw, and Livingston Counties

	FY19	FY20	FY21	FY22	FY23	1-YR	5-YR
Brain Cases	70	52	42	44	48	9.09%	-31.43%
Livingston Autopsies	99	123	137	120	25	-79.17%	-74.75%
Livingston Exams	9	26	28	32	3	-90.63%	-66.67%
UH (Adult) Autopsies	167	164	127	114	107	-6.14%	-35.93%
UH (Adult) Exams					1		
UH (Peds) Autopsies	27	24	24	28	23	-17.86%	-14.81%
Washtenaw Autopsies	351	344	378	336	383	13.99%	9.12%
Washtenaw Exams	62	67	104	100	101	1.00%	62.90%
Total	**785**	**800**	**840**	**774**	**691**	**-10.72%**	**-11.97%**

Wayne County ME Office Case Volume

	FY19	FY20	FY21	FY22	FY23	1-YR	5-YR
Full Autopsies	2,318	2,116	2,901	2,647	-	-100.00%	-100.00%
Externals	865	891	562	979	-	-100.00%	-100.00%
TOTAL	**3,183**	**3,007**	**3,463**	**3,626**	**-**	**-100.00%**	**-100.00%**

This practice strengthens our brand at regional and national levels, leads to research opportunities in rare diseases, is fundamental to the success of subspecialty fellowships, drives revenue, and enhances patient recruitment to Michigan Medicine.

Case Volume—In FY23, the extramural AP consultation practice total case volume was 32,472 which represents a 5.0% increase from FY22 and a 5.7% increase from 5 years ago.

Turnaround Time—Increased to an average of 4.1 days per case. This represents a 24.9% increase over last year and 4.8% slower turnaround time compared to five years ago. The increase in turnaround time is primarily due to changes in staffing.

Technical-Only Histological Service

Our histology laboratory offers outside laboratories access to our test menu including immunohistochemical and in situ hybridization stains, which are handled by our highly skilled technologists. For a limited menu, we also perform both technical stains and pathologist interpretation.

Case Volume—Cases were down 5.6% compared to FY22 at 2,092 and have decreased by 3.3% from five years ago.

Turnaround Time—Cases decreased by 15.3% from FY22 to 1.3 days and demonstrated a 57.9% decrease from FY19.

Personnel

In AP there are 66 faculty members that sign out, including many world-renowned pathologists. This does not include pathologists who are part of leadership or other divisions, and it also does not include active emeritus faculty. Since July 2022, 4 new faculty were hired. The service also involves 7 fellows.

Academic Activities

AP faculty excelled at fulfilling our research mission. AP pathologists collectively published 326 peer-reviewed articles in prestigious journals. Our faculty collectively delivered 142 presentations at regional, national, and international meetings and other institutions.

Education

Medical School Teaching/Graduate School Teaching

Under the organizational leadership of Dr. Lew, nearly 25 AP faculty participated in medical school teaching (M1-M4 students) including lectures, labs, and experiential learning. Several AP faculty members also participated in teaching and mentoring our graduate students.

Residency Program/Fellowship Program

AP faculty across disciplines dedicated many hours to teaching our residents and fellows. Residents in AP were exposed to excellent learning opportunities in surgical pathology, cytopathology, and autopsy/forensic pathology. AP fellows were exposed to challenging cases from our extensive consultation practice and participated in many multidisciplinary conferences and tumor boards.

Drs. Allecia Wilson *(left)* and Jeffrey Jentzen *(right)* hosting the 2023 Advances in Forensic Medicine & Pathology Conference.

Clinical Pathology

Riccardo Valdez, MD
Director, Clinical Pathology

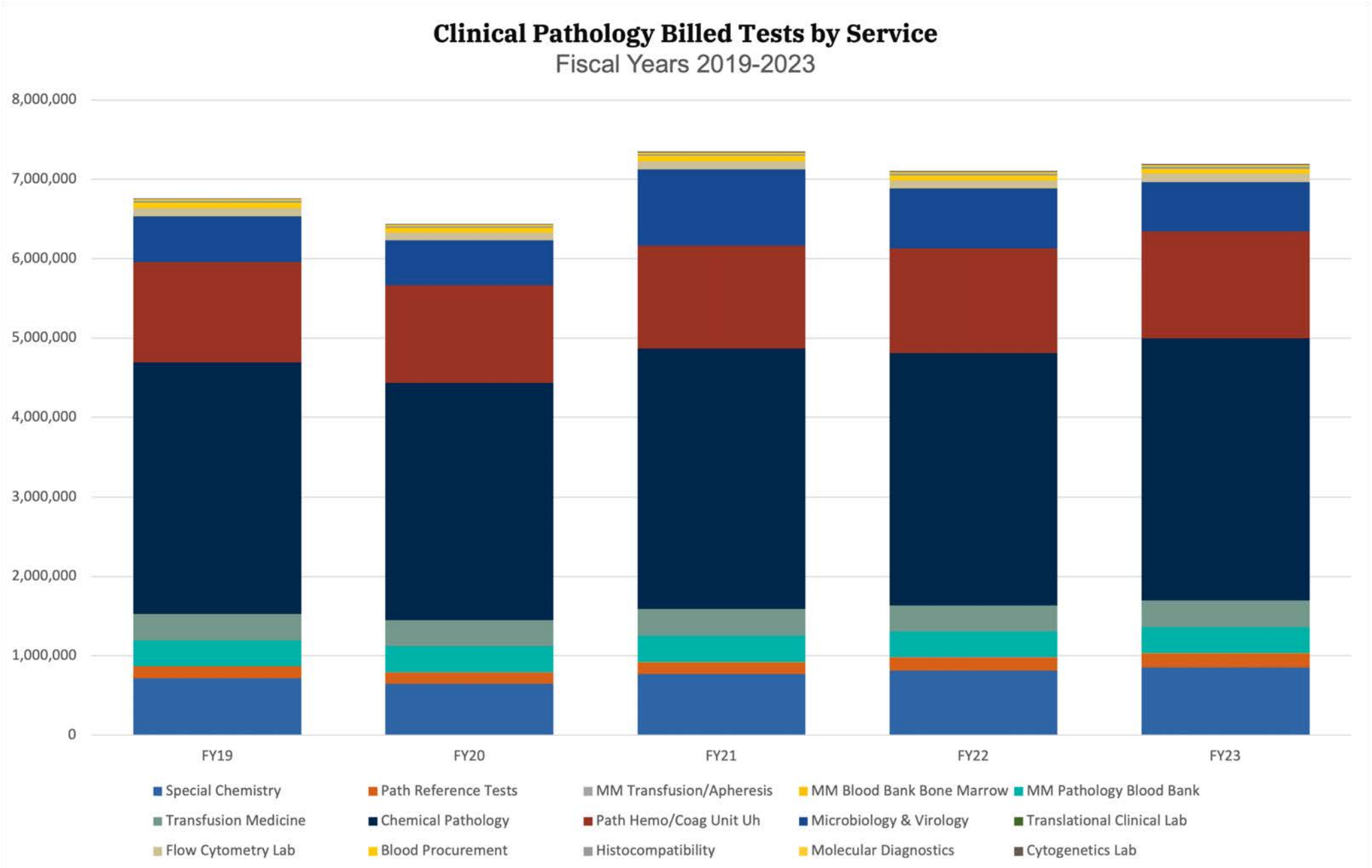
The Clinical Pathology Division (CP) encompasses the high-volume clinical laboratory, transfusion medicine, and point-of-care services of the Department of Pathology and Clinical Laboratories. Like the medical laboratories in the Anatomic Pathology and Molecular Pathology Divisions, the CLIA-certified and multi-agency accredited (CAP, AABB, ASHI, FACT) laboratories within the Clinical Pathology Division support the diagnosis and management of human disease using automated and/or manual testing of blood, body fluids, bone marrow, and fresh or fixed tissue specimens, augmented by medical interpretation and clinical consultation. The latter being an essential component of the value delivered to the clinical, educational, and the research areas of organization by the CP Division.

The medical laboratory disciplines and support services administered by CP in FY23 included Clinical Chemistry, Toxicology, Drug Analysis, Hematology, and Coagulation (Clinical Core Laboratory); Blood Bank, Apheresis, and Cell Therapy (Transfusion Medicine); Special Chemistry and Clinical Immunology; Clinical Microbiology; Bone Marrow Morphology and Flow Cytometry (Hematopathology); Clinical Cytogenetics; Molecular Diagnostics; Histocompatibility; Point-of-Care Testing; Onsite and Offsite Phlebotomy; and Specimen Processing. The Molecular Genetics and Biochemical Genetics laboratories of the Michigan Medicine Genetics Laboratories (MMGL) were formally added to the Department of Pathology and CP Division in November 2022. The MMGL previously shared infrastructure and CLIA resources with CP, but its administrative home was historically in the Department of Pediatrics.

The CP Division has twenty-eight active clinical faculty, three active emerita/emeritus faculty, and two active adjunct faculty members. Two new clinical faculty were recruited to the Division in FY23, both officially joining in July 2023: Matthew Najor, PhD was hired as the Associate Director of the Histocompatibility Laboratory, and Mark Girton, MD was hired as a diagnostic hematopathologist and clinical pathologist. Five members of the CP Division received academic promotions: Dr. Matthew Cusick promoted to Associate Professor; Dr. Paul Lephart promoted to Associate Professor; Dr. Anamarija Perry promoted to Professor; Dr. Lina Shao promoted to Professor; Dr. Riccardo Valdez promoted to Professor. These promotions were effective in September 2023.

The medical laboratories in the CP Division achieved 7,308,283 billed tests and $1,038,936,855 in gross charges in FY23, representing increases of 1.3% and 3.7% year over year, but with overall increases of 7.5% and 20.1% respectively, over the past five years. *(See table on pg. 82)* Overall laboratory staffing continued to steadily improve in the past year, but phlebotomy staffing, especially for the onsite services, remained problematic despite significant efforts to hire and retain personnel. The overall number of allied health staff supporting the work of the CP laboratories increased to approximately 850 during the past year through concerted efforts and cooperation among our departmental and hospital operations leaders and human resources services. While the laboratory services provided by the CP Division (including management and medical direction) largely occur at the University Hospital and NCRC sites, the CP Division also oversees the services at all offsite laboratories, including (but not limited to) West Ann Arbor, Northville, Brighton Center for Specialty Care, Domino Farms, Kellogg Eye Center, and East Ann Arbor Surgery.

The UH Clinical Laboratory portion of the Pathology Relocation and Renovation Project (PRR) continued to proceed as planned with successful activation of the new inpatient phlebotomy work area, cell therapy laboratory, and staff break room. Another major achievement was the implementation of two instruments for automated specimen handling at the interface of the specimen processing and core laboratories. These sophisticated


Clinical Pathology Billed Tests by Service
Fiscal Years 2019-2023
8,000,000
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
FY19
FY20
FY21
FY22
FY23
Special Chemistry
Path Reference Tests
MM Transfusion/Apheresis
MM Blood Bank Bone Marrow
MM Pathology Blood Bank
Transfusion Medicine
Chemical Pathology
Path Hemo/Coag Unit Uh
Microbiology & Virology
Translational Clinical Lab
Flow Cytometry Lab
Blood Procurement
Histocompatibility
Molecular Diagnostics
Cytogenetics Lab

Carmen Gherasim, PhD
Director, Clinical Core Laboratory

instruments were added to further improve efficiency and throughput for high volume testing on the automation lines.

The anticipated, routine biennial clinical laboratory inspection by the College of American Pathologists (CAP) occurred in May 2023. An 18-member team from the University of Alabama at Birmingham inspected our seven CAP-accredited sites (UH/Main, NCRC, Northville, WAA, BCSC, KEC, and EAA Surgery) using a hybrid inspection model whereby an initial controlled document review occurred prior to the traditional onsite in-person inspection process took place. All inspected sites and clinical laboratory areas (CP, AP, and Molecular Pathology) did extremely well with a total of seventeen citations recorded by the CAP after onsite corrections and challenges to initial deficiencies. This is identical to the number of citations received during the 2021 external inspection and fewer than the 50 and 55 citations received during the 2017 and 2019 inspections. Reagent handling and personnel records remain among the common themes for the observed deficiencies.

Clinical Core Laboratory Section

The Clinical Core Laboratory (CCL) is located on the University Hospital main campus and provides 24/7/365 clinical testing for hundreds of different health- and disease-related analytes in blood, urine, or body fluids. The around-the-clock staff support the inpatient, outpatient, and emergency service practices for adult and pediatric patients. In addition, the CCL performs testing for patients seen at our offsite laboratory and medical practice locations (e.g., West Ann Arbor, Northville, Canton, East Ann Arbor, Brighton Specialty), as well as from our MLabs patients. The CCL is medically supported by Drs. Carmen Gherasim, Sean Li, David Manthei, Steven Pipe, Riccardo Valdez, and Jeffrey Warren. Drs. Shane Quinonez and Ayesha Ahmad from the Department of Pediatrics provide medical leadership for the Biochemical Genetics Laboratory (BGL), which was added to the CP Division in November 2022. Eric Vasbinder and Todd Ackley served as the Administrative Managers for the CCL and BGL, respectively, and provided essential leadership for their laboratory staff teams. In 2022, Kristy Wendt and Amy Rosendaul were selected as chief technologists for the Hematology and Coagulation Laboratories and Chemistry, Toxicology and Emergency Department Laboratories, respectively. CCL chief technologists are working closely with the CCL manager, Eric Vasbinder, and the faculty in maintaining regulatory compliance, continuing the internal organization and quality improvement efforts, and expanding the test menu. In FY23, a small subsection of the Microbiology laboratory from UH was added to the operational oversight of the CCL while retaining the medical oversight by the Microbiology faculty, Drs. Michael Bachman, Paul Lephart, and Virginia Pierce.

Clinical Chemistry, Drug Analysis, Toxicology, Emergency Services

This subsection of the CCL performs STAT and routine testing in the areas of general chemistry, endocrinology, drug analysis, and toxicology. The test menu includes routine chemistries (electrolytes, creatinine, liver function, glucose, and proteins), lipids, vitamin testing, cardiac markers, tumor markers, reproductive hormones, hepatitis serology testing, metals testing (e.g., lead), therapeutic drug monitoring, drug of abuse testing, and intraoperative parathyroid hormone testing. The area is equipped with state-of-the-art automated analyzers utilizing spectrophotometry, immunoassays, mass spectrometry, and other methods for a full range of diagnostic testing. The clinical labs in the Adult and Children's Emergency Services areas are administered by the chemistry section of the CCL. With many COVID testing sites closing in FY23, the CES laboratory continued to support diagnostic COVID testing using the Abbott ID NOW COVID for both symptomatic and asymptomatic patients where a rapid TAT was needed to support clinical decision making.

In FY23, Chemistry performed 3,297,181 billed tests with a 3.8% increase in total testing compared to FY22, 7.1% increase in outpatient tests and a small decrease (0.4%) in inpatient testing continuing an upward trend in the testing volume. Toxicology lab performed 108,856 tests; a 14.2% increase compared to FY22. The volume of COVID-19 diagnostic testing in CES labs remained high in FY23 at 65,794 tests, a 4% increase compared to FY22 with a decrease in testing volume starting May 2023. Increased efficiencies in operations decreased the overtime in the Chemistry labs by 41% compared to FY22.

Additional highlights from this area include:

- Validation and implementation of soluble transferrin receptor testing to aid in the evaluation of patients with iron deficiency anemia vs. anemia of chronic disease.
- Validation and implementation of NephroCheck testing for AKI risk assessment in post-cardiac surgery patients to decrease AKI and length of stay.
- Validation and implementation of Thyrotropin receptor antibody immunoassay for diagnosis and management of autoimmune thyroid disease.
- Development, validation, and implementation of a salivary cortisol assay by LC-MS/MS for screening of adrenal hyperfunction (Cushing syndrome).
- Validation and implementation of a Rapid Hemoglobin S quantification by HPLC for management of patients with sickle cell disease.
- Validation and implementation of fentanyl screening by immunoassay to aid in identification of prescribed and illicit fentanyl and designer fentanyl with an improved TAT compared to the existing LC-MS/MS assay.

Hematology and Coagulation

This subsection of the CCL performs automated and manual testing to measure the various components of blood and body fluids (e.g., red blood cells, white blood cells, and platelets), identify and quantitate abnormal cells, assess clotting factor levels, determine the impact of medications on blood clotting processes, and help diagnose diseases of kidneys and urinary tract. Quantitative flow cytometry is performed on peripheral blood and stem cell harvest products to assess CD34-positive stem cells in support of the Transfusion Medicine Section and the clinical stem cell transplant program. The CCL hematology lab also remains involved in the bone marrow biopsy process, providing lab technicians to assist these bedside clinical procedures.

The hematology and coagulation areas of the CCL performed 1,348,313 billed tests in FY23, a 2.2% increase over last year. These lab areas have experienced a 6.3% increase in billed tests and 3.8% increase in gross charges over the past five years. The hematology and coagulation lab areas benefited from completion of the core chemistry automation line project and continue to work closely with the chemistry area and specimen processing service to improve preanalytical workflows using new pre-analytical instruments added this past year.

Additional highlights from this area include:

- Completed the Request for Proposal process and decision to replace the Arkray urinalysis instruments with the Sysmex UN-3000 urinalysis system and advanced plans for the replacement including minor CCL renovation and completion of validation plans.
- Selected and obtained new Sysmex PS-10 sample prep instrument and XF-1600 flow cytometer to replace existing instruments.
- Validated and implemented the VWF GPIbM Activity assay to provide more reliable results without interference of D1472H polymorphism than the VWF (Ristocetin co-factor) assay.
- Increased hours at the Northville Health Center lab to support infusion patients' needs (5 8-hour shifts to 5 12-hour shifts).
- On-going Q-Flag study to improve instrument flagging sensitivity to reduce number of slides manually reviewed and improve patient result turnaround time.
- Validated and implemented a new method to test Protein C Antigen with reduction in cost per test from $50.98 to $28.91, due to reduced labor expense.
- Implemented an individualized quality control plan for BinaxNow Malaria Antigen test.

Michigan Medicine Genetics Laboratory—Biochemical Genetics Laboratory

Drs. Shane Quinonez, Ayesha Ahmad, and Catherine Keegan from the Department of Pediatrics provided technical and medical direction of the BGL in FY23 (Pathology), with Todd Ackley serving as the administrative manager for the laboratory.

Daniel Boyer, MD, PhD
Director, Clinical Flow Cytometry Laboratory

David Manthei, MD, PhD
Section Director, Clinical Immunology & Special Chemistry

Robertson Davenport, MD
Director, Blood Bank and Transfusion Service

Chisa Yamada, MD
Director, Apheresis Services

Laura Cooling, MD
Director, Cellular Therapy Laboratory

The BGL performed 2,968 billed tests in FY23, similar to FY22 volume (2,652), with fewer staff compared to prior years due to unexpected departures. The BGL has 2 Medical Technologist positions. Both positions turned over last year (June 30, 2022 & September 23, 2022), impacting laboratory operations. Replacement Medical Technologists were hired in August 2022 and January 2023. The laboratory was being operated by one Medical Technologist for three months and the same individual had to train the 2nd MT and perform laboratory testing for an additional two months, effectively leaving the lab with one MT for five months. This situation resulted in some laboratory testing (acylcarnitines, methylmalonic acid, and plasma amino acids) being sent to a reference laboratory until staffing levels stabilized.

Major activities for the laboratory started in FY23 and ongoing include re-validation of acylcarnitine testing (with target go-live date in Q3 FY24) and amino acid monitoring via dried blood spots testing planned with further development to begin in Q3 FY24.

Lidong Zhai, Ph.D was hired in FY23 with a start date in early FY24. Dr. Zhai will serve as the BGL director (Technical Supervisor), and Drs. Quinonez and Ahmad will continue to assist with test interpretation and serve as Clinical Consultants.

Clinical Immunology & Special Chemistry Section

The Clinical Immunology and Special Chemistry labs perform testing to assess immune responses in patients with autoimmune, infectious, and other similar conditions; testing for patients with protein disorders such as those seen in multiple myeloma and related disorders; and hemoglobin evaluations in patients with suspected red blood cell disorders. The following CP faculty provided clinical service in this section in FY23: Drs. David Manthei (section director), Jeffrey Warren, David Keren, David Ferguson, Lee Schroeder, Sean Li, and Carmen Gherasim. In combination, these laboratories performed approximately 469,117 tests in FY23, representing a 5.5% increase over the approximately 444,523 tests performed in FY22. Longitudinal year-over-year comparisons for these two areas remains complicated by the historical organization of these labs within the clinical chemistry section.

Area	FY22	FY23	% Change
Special Chemistry	159,818	176,056	10.2%
Clinical Immunology	284,705	293,061	2.9%
Total	**444,523**	**469,117**	**5.5%**

Highlights from this section include:

- Anti-glomerular basement membrane antibody methodology changed to automated method.
- Rework of staffing for additional cross-coverage and ability to adapt to increasing volumes of manual work.
- Collaboration with clinical stakeholders to refine ordering of tests including autoantibody tests.
- Continued detangling of cost/revenue streams from the CCL.
- Planning for equipment replacement needs with space assessment.
- Implementation of new test Aspergillus Ag (Galactomannan).

Transfusion Medicine Section

The Transfusion Medicine Section consists of the following main and sub areas: Blood Bank, Immunohematology Reference Lab, Apheresis Procedure Unit, and Cellular Therapy. The section was supported by the following faculty during the last year: Drs. Laura Cooling, Robertson Davenport, Chisa Yamada, and Sean Li. Active recruitment for this area occurred in FY23 with two new junior faculty to join the section before the end of CY23.

Overall blood product utilization was stable in FY23 compared to FY22 except for the continuing decrease in fresh frozen plasma transfusion trending since FY21. The Blood Bank continued its participation in two multi-center phase 3 clinical trials, the Chilled Platelet Study (CHIPs), and the Study to Evaluate the Efficacy & Safety of the INTERCEPT Blood System for RBCs in Complex Cardiac Surgery Patients (ReCePI), and its collaboration with colleagues in Pediatric Surgery and Obstetrics and Gynecology on the exploration of red blood cell units derived from umbilical cord blood. The Immunohematology Reference Laboratory saw a small decrease in overall testing volume; however, the volume of BMT blood type and antibody screen

testing dramatically increased due to an intended shift away from alternative utilization of pre-transfusion type and screen orders for this purpose. *(See table on pg. 82)*

The Cellular Therapy Laboratory (CTL) saw the completion and activation of its new facility as part of PRR. As clinical operations in BMT continue to grow, so have the activities in the CTL, with the most notable relative increase in the exciting field of CAR-T therapies. Accordingly, the CTL supported protocols for twenty-one commercial or investigational cellular therapies in FY23. The Apheresis Procedures Unit performed over 2,300 procedures in FY23, similar to FY22. Reflecting the increased CAR-T product volume reported by the CTL, the APU saw increased donor pre-evaluations and increased CAR-T therapy collections. LDL apheresis procedures notably decreased as more novel drug therapies became available for adult patients with homozygous familial hypercholesterolemia.

Other notable initiatives in FY23 included:

- Participation in clinical enterprise-wide quality improvement project aimed to increase visibility on blood product supply through different communication efforts, forecast and plan for clinical operation needs, and improve product utilization.
- Transition of new administrative manager into the section following the retirement of Terry Downs.

Hematopathology Section

This section focuses on the evaluation of blood, bone marrow, lymph nodes, and other tissue to asses for benign, reactive, and neoplastic disorders, using a variety of techniques including routine microscopy (morphology), flow cytometry, and immunohistochemistry with incorporation of data from cytogenetic and molecular diagnostic testing in a vast majority of cases. This section was supported by eight hematopathologists in FY23 (Drs. Daniel Boyer, Robert Bell, Noah Brown, Anamarija Perry, Charles Ross, Russell Ryan, Lauren Smith, and Riccardo Valdez) who variably participate on each of three clinical services (in-house biopsies, flow cytometry/blood and body fluid smear interpretation, and transfer and consult case interpretation). Two of the primary hematopathology section faculty participated in the interpretation of myeloid next-generation sequencing test interpretation in FY23 with more faculty expected to provide those diagnostic services in the coming years. Case volumes continued to increase to at or above pre-COVID numbers in FY23. In FY23, 2,281 bone marrow and other tissue biopsies collected from Michigan Medicine patients were diagnosed and signed out by the hematopathology team, compared to 2,784 in the previous year. The diagnostic service also managed 1,161 cases from external healthcare systems associated with patients seeking care at Michigan Medicine and 1,680 external cases sent by other pathologists for primary diagnosis or expert opinion. The flow cytometry lab performed 103,741 billed tests in FY23 compared to 101,563 in FY22, a 2.2% increase. Of note, the test volume in flow cytometry specifically includes 5,898 leukemia and lymphoma immunophenotyping panels. Over the past five years, flow cytometry lab test volume has decreased 1.76% based on billed tests; however, there has been a 15.9% increase in volume over the past five years based on actual flow cytometry tests performed for leukemia and lymphoma immunophenotyping.

Notable FY23 achievements in this section include:

- Completion of four new laboratory developed flow cytometry panels (Myeloid+T, Myeloid+B, Myeloid+P, and Monocytic) leading to increased specificity and consistency for identifying abnormal population in clinical samples.
- Planning and preparation for additional panel revisions and updates to include T-ALL, HCL, B-ALL MRD, and PNH.
- Onboarding of new hematopathologist at the beginning of FY23 (Dr. Robert Bell).
- Selection and hiring of additional hematopathologist to join the section at the beginning of FY24 (Dr. Mark Girton).
- Transition of diagnostic service operational activities to hematopathology administrative manager, administrative assistants, section faculty, and section director following the retirement of Denise Sulavik.

Clinical Microbiology Section

The Clinical Microbiology Laboratory consists of multiple subspecialty areas (bacteriology, virology, mycology,

Daniel Boyer, MD, PhD
Service Director, Hematopathology

Michael Bachman, MD, PhD
Associate Director, Clinical Microbiology Laboratory

Paul Lephart, PhD
Associate Director, Clinical Microbiology Laboratory

Virginia Pierce, MD
Associate Director, Clinical Microbiology Laboratory

Matthew Cusick, PhD
Service Director, Histocompatibility Laboratory

mycobacteriology, parasitology, antimicrobial susceptibility, molecular microbiology, and the core microbiology laboratory). These lab areas focus on identifying bacterial, fungal, parasitic, and viral pathogens to aid in the diagnosis and treatment of patients. The section was again supported by three CP faculty during the past year, with Dr. Virginia Pierce joining Drs. Michael Bachman and Paul Lephart in providing medical direction for the clinical microbiology laboratory in July 2023.

In FY23, the Clinical Microbiology Laboratory performed 627,379 total billed tests compared to a total of 752,331 the previous year, representing a 17% decrease from the prior year. The decrease in test volume is attributable to decreased COVID testing by PCR for pre-admission screening and symptomatic patients. However, the FY23 volume represents an 18.8% increase in testing compared to pre-pandemic (FY19) levels.

During FY23, the Clinical Microbiology Laboratory successfully implemented the following:

- Successful onboarding of Dr. Virginia Pierce as Associate Director of the clinical microbiology laboratory.
- Hepatitis C viral load testing on the random access Alinity m platform to enable rapid turnaround time to support patient management after HCV-positive organ transplantation.
- HIV viral load testing on the Alinity m platform, enabling on demand testing and reduced turnaround time.
- Rapid molecular identification of Mycobacterium tuberculosis from culture specimens, mitigating the elimination of the current rapid test from the market.
- Second generation rapid molecular blood culture identification (BCID2), enabling the identification of a larger set of pathogens causing bloodstream infections and their associated antibiotic resistance markers within hours of a positive blood culture.
- Restored in-house testing for Ova and Parasites, which had been sent out to compensate for COVID testing volumes.
- Transition of operational leadership of the Microbiology Core Laboratory to the Core Lab Supervisor and Manager, enabling on-site support for staff.
- A searchable database of quality assurance reports enabling rapid feedback to staff, trend analysis and data summaries.

Overall, FY23 has been a successful period of building a foundation of quality and clarified operational structure. This will enable the transition to additional next-generation assays for viral loads and human papillomavirus testing, and to improve workflows for laboratory automation of bacteriology testing in FY24.

Histocompatibility Laboratory

The Histocompatibility (HLA) Laboratory performs an array of clinical tests used to help determine compatibility between donors and recipients and to assess immunologic risks associated with solid organ and stem cell transplantation. The HLA lab also performs testing for other clinical purposes such as disease association. The analytical techniques used in this laboratory area include serologic methods, flow cytometry, and molecular methods including next-generation sequencing. The latter was implemented during the prior fiscal year and has yielded the numerous anticipated advantages to the service, including elimination of additional typing tests needed to resolve patient HLA ambiguities, improved workflow, and conservation of supply and personnel resources. It has also resulted in improved turnaround times, lower overall expenses, and higher quality test results.

The clinical testing activity of the HLA laboratory over the past four years is shown below:

	FY20	FY21	FY22	FY23
Disease Association	1,961	1,739	1,558	1,638
High Resolution Typing	1,469	1,477	3,842	5,952
Low Resolution Typing	1,729	3,979	4,501	4,905
Antibody Screening	3,618	3,687	2,068	3,903
Antibody Specificity	9,801	10,801	13,552	13,167
Flow Cytometry Crossmatch	521	526	392	475

As part of its mission to support clinical transplantation, the HLA lab faculty and staff are available 24/7/365 to provide help and consultation to the direct care providers deciding if and/or how to proceed with an organ or stem cell transplant. In the past year, Dr. Marcelo Pando (a contracted HLA consultant) has helped provide clinical director service, particularly after hours. In addition to CAP accreditation, the HLA laboratory also maintains accreditation by the American Society for Histocompatibility and Immunogenetics (ASHI).

Notable highlights for FY23 include:

- Successful faculty search and hire of new Associate Director (Matthew Najor, PhD).
- Advancement of cross training efforts between the molecular and serology areas of the laboratory, necessary to increase overall depth and expertise.
- Quality improvement project to address duplicate requests of HLA tests with goal to decrease duplicate typing order by 25%.
- Initiation of project to provide discrete donor specific antibody (DSA) results in EMR so that transplant team can track and trend.

The substantial efforts made by the HLA manager and director over the past few years working together has yielded the progress noted above in addition to the revenue growth shown in the graph below.

Point-of-Care Testing Section

Point-of-Care Testing (POCT) is clinical laboratory testing performed at or near the patient's bedside by thousands of operators throughout Michigan Medicine in both the inpatient and ambulatory care settings. The operators include nursing and other non-traditional laboratory-trained personnel. Testing ranges from the simpler (waived) glucometer and urine pregnancy tests to more complicated (non-waived) blood gas and viscoelastic testing to assess coagulation status in places such as the operating rooms.

The POCT team, led by Dr. Lee Schoeder (Section Director) and Andrew Szczembara (Administrative Manager), supports clinical units with laboratory instruments, reagents, operator training, quality assurance, and regulatory guidance. Their mission is to improve patient health by providing access to safe and efficient laboratory testing at the point-of-care, through technology, service, and education.

A significant component of POCT services is the provision of training and quality assurance throughout the enterprise. In FY23, this consisted of:

- Training hundreds of operators to perform point-of-care testing in blitzes as well as targeted educational sessions to a number of groups: Nursing, Anesthesia, Radiology, Labor and Delivery, Survival Flight, ECMO, physician offices, ambulatory health centers, surgery and procedure centers, Pinckney Student Run Free Clinic and Regional Alliance of Healthy Schools program.
- Maintaining the glucometer program, which includes over 600 glucometers, over 13,000 operators, and 514,000 patient tests in FY23.
- Managing over twenty different test systems and over 800 instruments for point-of-care testing.
- Performing over 450 quality assurance rounds and troubleshooting visits at the various supported sites.
- Successfully navigated the Soft Global upgrade.

Additional notable initiatives for FY23 included the following:

- Planned, coordinated, and performed verification and validation of the new ROTEM Sigma platform, with anticipated implementation in early FY24.
- Successfully upgraded middleware GemWeb Plus and RALS for the anticipated launch of Rotem Sigma.
- Launched the Hemochron Signature Elite Interface for Activated Clotting Time in the Cath Labs, EP Labs, and CPU Labs.
- Facilitated laboratory accreditation biennial inspections at Domino's Farms MEND, Canton Health Center, Livonia Center

Lee Schroeder, MD, PhD
Section Director, Point of Care Testing

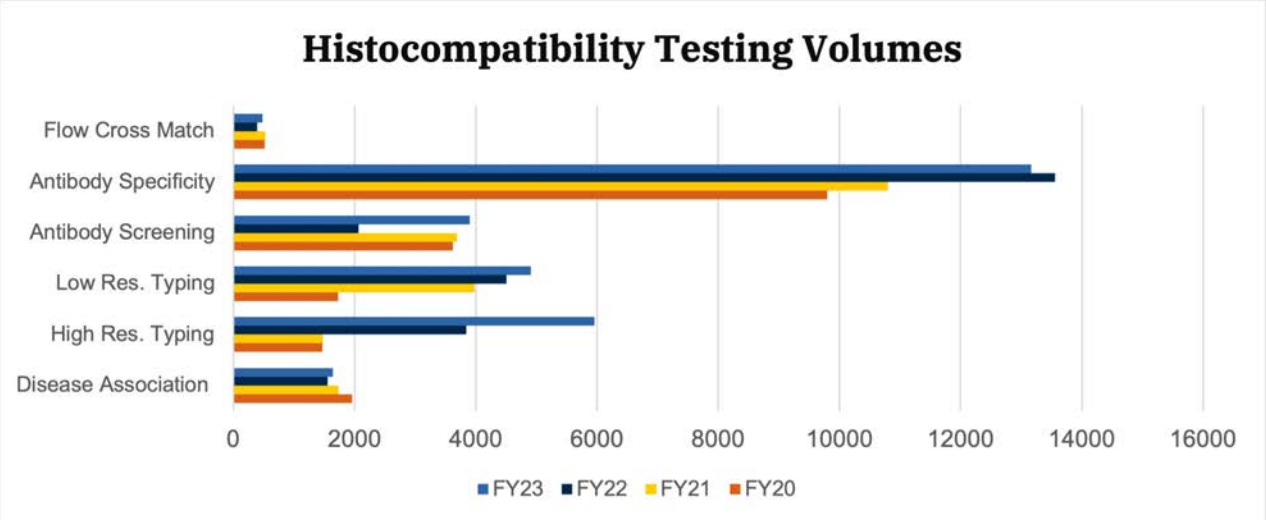


Table: *HLA Revenue Growth*

for Specialty Care, Northville Health Center, Brighton Center for Specialty Care, East Ann Arbor Surgery Center, West Ann Arbor Health Center, Kellogg Eye Center, and Main Campus.

A sampling of test volumes for some tests performed at the point-of-care is shown below.

Test Name	Patient Tests FY22	Patient Tests FY23
POC Glucose (Glucometer)	530,749	514,891
POC UA (Clinitek)	52,852	56,644
POC Blood Gas/Electrolytes	36,580	39,132
POC PT/INR	25,381	21,327
POC Hemoglobin A1C	23,056	22,423
POC Urine Pregnancy	19,720	20,645
POC Activated Clotting Time	18,000	16,798
POC Strep Antigen	7,749	10,789
PPM Urinalysis	8,287	5,885
ROTEM	5,405	5,495
POC Sars-CoV-2	4,655	2,728
POC Protime-INR	2,196	3,495
POC Urinalysis Manual	3,630	2,387
POC Sars-Cov-2/Flu/RSV	3,498	3,201
POC Specific Gravity	3,097	2,889
PPM Wet Preparation	1,653	1,350
POC Urine Drug Screen	1,503	1,386
POC Basic Metabolic Panel (i-Stat)	1,456	1,643
POC OR CBC	1,469	1,553
POC Creatinine (i-Stat)	1,044	1,042

Thomas Giordano, MD, PhD
Director, Molecular and Genomic Pathology

Molecular & Genomic Pathology

Molecular diagnostics is the science of analyzing biological markers in the genome and proteome, an individual's genetic code, to determine how cells express their genes as proteins. Several specialized laboratory techniques are utilized to diagnose and monitor disease, determine response to therapy, assess risk of relapse, and help determine which therapies will work best for individual patients. The Division of Molecular and Genomic Pathology has made considerable progress toward realizing its overarching goals of facilitating a coordinated strategy for the various clinical laboratories performing molecular tests within the Department of Pathology, and interfacing with Michigan Molecular Genetics Laboratory (MMGL) administered by the Department of Pediatrics. Two major accomplishments were achieved in FY23 which will accelerate the continued evolution of molecular diagnostics in our clinical laboratory. First, the administrative home of the MMGL was transitioned from the Department of Pediatrics to Department of Pathology and Clinical Laboratories in November 2022. This will further facilitate integration of resources and alignment of overall strategy. Second, Dr. Annette Kim was hired as the new Division Director for Molecular and Genomic Pathology with a start date at the beginning of FY24. This critical recruitment will provide the additional expert leadership necessary to enable technological advances and to define the strategic objectives for this increasingly important clinical and research area.

Molecular Diagnostics Laboratory

The Molecular Diagnostics Laboratory (MDL) performed 20,458 billed tests in FY23, which is a 7% increase over FY22 (19,098). Staffing for this part of the clinical laboratory operation remained stable in FY23. Notable changes in the CP faculty supporting the MDL include the addition of Dr. Robert Bell as a diagnostic molecular pathologist as well as the area's first faculty clinical informatician.

As in previous years, the MDL was successful in completing their test development goals with two noteworthy examples shown below:

- Neuropathology Methylation Array – Methylation profiling to aid in the diagnosis and classification of neurological neoplasms, 8/31/2022.
- Microsatellite Instability (MSI) using Long Mononucleotide Repeats (LMR) – Lynch syndrome screen using LMR markers with improved detection of MSI, particularly in non-colorectal cancers and Lynch syndrome due to MSH6 mutations, 3/16/2023.

In addition, the following initiatives were pursued in FY23 with target completion dates in early FY24:

- IGH-MYC Dual Fusion FISH – Detection of MYC rearrangements that may be missed by break-apart FISH and are important for classification and treatment of large B-cell lymphoma as well as Burkitt lymphoma (Go-Live 11/8/2023).
- Solid Tumor Fusion Panel – Detection of a broad range of diagnostic and targetable fusions in solid tumors including bone and soft tissue, neuro-oncology, head and neck, dermatological, gastrointestinal, genitourinary, and gynecological (Go-Live 1/3/2024).
- Myeloid NGS version 4 – Addition of UBA1, SAMD9, SAMD9L, CUX1, RHOA sequencing for detection of mutations involved in VEXAS syndrome (UBA1), MIRAGE syndrome with predisposition to myeloid neoplasms (SAMD9, SAMD9L), another gene with pathogenic mutations in myeloid neoplasms (CUX1) and mutations in angioimmunoblastic T-cell lymphoma (RHOA) (Go-Live 9/27/2023).
- Clinical MiOncoseq – Transitioning MiOncoseq – a comprehensive genomic profiling (CGP) assay performed by the Michigan Center for Translational Pathology (MCTP) to assay performed by the Molecular Diagnostic Lab and orderable and reportable as any other clinical test.
- Validation of combined cell-free and cellular DNA from fluids including cerebrospinal fluid, vitreous humor, and aqueous humor for MYD88 L265P mutation and IGH and IGK B-cell clonality testing.
- Neuropathology Methylation Array Update – Updating to Infinium Methylation EPIC v.2.0 as well as DKFZ Brain Classifier 12.5.
- Evaluation of alternative, EDTA-based decalcification methods for improved molecular and immunohistochemical testing.

Lastly, cost savings and revenue generation were important parts of the MDL efforts in FY23 to include the following:

- Practice changes to purchase a larger quantity of our AMPure bead reagent for our Next Generation Sequencing testing, resulting in a savings of $10.69 per NGS sample and savings of $13,000 per year with the two NGS assays we are currently performing.
- Instituted billing for preliminary FLT3 testing (missing revenue) in April of 2023, with estimated gross revenue of $800,000 and net revenue of $211,200.
- Instituted microdissection fees for samples that are extracted separately for different assays. This was missing revenue that was lost on only billing one sample when as many as three separate extractions were performed. Gross revenue is $2,462,436. Net revenue is $650,083.10.

Clinical Cytogenetics Laboratory

Cytogenetic testing involves analysis of bone marrow, blood, or fresh tissue specimens to look for changes in chromosomes, including rearrangements, additions, deletions, or insertions of genetic material. Changes in chromosome number or structure may be a sign of a genetic disease or condition and may help

Noah Brown, MD
Director, Molecular Diagnostics Laboratory

Lina Shao, PhD
Director,Cytogenetics

diagnose some types of cancer.

The primary tests performed in the Clinical Cytogenetics lab are the karyotype, fluorescence in-situ hybridization (FISH; fresh and paraffin embedded tissue), and genomic microarray. Enhancements to increase the sensitivity are often performed including pre-analytical cell separation and mitogen stimulation of cultures.

The Clinical Cytogenetics Laboratory performed 16,192 billed tests in FY23, which was similar to FY22 (16,315). Laboratory staffing numbers remained stable in FY23. Dr. Aiko Otsubo was successfully onboarded and integrated into the cytogenetics (and molecular genetics) clinical services, joining Drs. Lina Shao and Chen Yang in providing technical support and test interpretation.

The Clinical Cytogenetics Laboratory continued to improve patient testing and workflow during the past year with the following points representing highlighted projects and initiatives:

- Updated cost and billing CPT codes for all tests within clinical cytogenetics.
- Implemented an education program for Medical Laboratory Scientist Interns rotating through clinical laboratories.
- Trained and graduated the first Laboratory Genetics & Genomics (LGG) fellow in June 2023. Dr. Benajmin Kang was hired as Assistant Professor at Vanderbilt University Hospital following completion of his training.
- Advanced prior goals to add Hanabi automated cell harvester and Bionano Optical Genome Mapping instruments to the laboratory. These instruments will bring modern technology to assist with automating cell harvesting and move the lab toward next generation cytogenomics by using Optical Genome Mapping which can detect both copy number and structural abnormalities at remarkably high resolution.

Chen Yang, PhD
Director, Molecular Genetics Lab

Michigan Medicine Genetics Laboratory—Molecular Genetics Laboratory

The MGL was directed by Drs. Chen Yang (Pathology) and Catherine Keegan (Pediatrics) during the past year, with Todd Ackley serving as the administrative manager. The MGL performed 1,580 billed tests in FY23, similar to FY22 (1,699), and the laboratory was staffed at prior year levels.

Clinical test development and service improvement were a major focus during the past year with the following notable accomplishments:

- Coffalyser software update verification (9/7/2022) – Essential software for analyzing Methylation-Specific Multiple Ligation Probe Amplification (MS-MLPA) in imprinting disorders, and SMN1&2 Copy Number Analysis in Spinal Muscular Atrophy (SMA-MLPA).
- GDCMA Chromosomal Microarray Analysis, Germline (6/20/2023) – Detection of constitutional copy number variant (CNV) and region of homozygosity (ROH) with GDAC microarray of 1.8 million markers at improved resolution, in comparison to the previous 850k microarray with 850 thousand markers.
- Saliva sample as alternative to peripheral blood for NGS, Sanger sequencing, CytoScan Xon array, and GDCMA assays (6/20/2023) - Small scale pilot program with the Hereditary Breast and Ovarian Cancer Clinic and Pediatric Genetics.
- Assisted the MolDx laboratory in bringing up, validating (10/01/2022), and performing clinical runs of their Neuropathology Methylation Array.

In addition to the completed items above, the MGL had several ongoing test development activities started in FY23 with completion dates in early FY24. These efforts include the following:

- PHOX2B Gene Sequencing – Detection of pathogenic variants including the common mechanism of polyalanine repeat expansion in PHOX2B gene in patients with a phenotype consistent with congenital central hypoventilation syndrome or neuroblastoma with Hirschsprung disease. Targeted go-live date Q1 FY24.
- Illumina GDCMA Custom Reference Cluster File - A custom file, in comparison to the vendor-provided reference file, will improve the signal/noise ratio and save analysis time for GDCMA microarray. Targeted go-live date Q2 FY24.
- Newborn Screening (NBS) NGS panels – These NGS panels

(total ~32) will be used as follow-up testing to confirm diagnosis in individuals with positive NBS results (performed at the State of Michigan Laboratory) or who have a phenotype consistent with the associated metabolic disease. Targeted go-live date Q1 FY24.

- Noonan Syndrome & RASopathies Expanded NGS panel (28 genes) – A comprehensive panel for detecting pathogenic variants in patients with a phenotype consistent with Noonan Syndrome and other related RASopathies. Target go-live date Q3 FY24.
- FMR1 methylation PCR using Asuragen AmplideX mPCR kit – A methylation-sensitive enzyme digestion-based PCR assay will provide more informative FMR1 (CGG repeat expansion premutation and full mutation) allele specific and semi-quantitative methylation status, in comparison to the current Qiagen EpiTect Bisulfite conversion based qualitative methylation assay.
- Saliva kit validation is ongoing for Fragile X, SMA-MLPA, and MS-MLPA assays. Target go-live date Q2 FY24.
- Working with MLabs and MiChart to operationalize sending saliva kits to patient homes for all MM and MLabs patients. This should claw back in-house germline genetic testing that is being sent to reference laboratories. Targeted go-live date to be determined.
- Assisted the Cytogenetics laboratory in bringing up, validating the GDAC array for cancer testing. Targeted go-live date in FY24.

Lastly, the MGL identified cost savings initiatives including:

- Converting from the Illumina CytoSNP850K array to the GDAC array, based on 800 samples, will result in a yearly saving of $100,000.
- Established criteria for high-quality NGS sequencing variants and reserved Sanger confirmations for only low-quality sequencing variants detected from NGS, resulting in cost savings of $13,537 per year, by avoiding approximately 100 unnecessary Sanger sequencing.

Michigan Center for Translational Pathology

Arul M. Chinnaiyan, MD, PhD
Director, Michigan Center for Translational Pathology

The research in MCTP focused on functional genomic, proteomic, and bioinformatic approaches to study cancer for the purposes of understanding cancer biology as well as to discover clinical biomarkers, continues to progress, resulting in high-impact discoveries. Summaries from a few of the major published studies over the past year are provided below.

Cancer Biology/Clinical Genomics

Argonaute 2 modulates EGFR-RAS signaling to promote mutant HRAS and NRAS-driven malignancies:

Our prior work described an essential role for Argonaute 2 (AGO2), of the RNA-induced silencing complex, in mutant KRAS-driven cancers. Here, we identified a novel endogenous interaction between AGO2 and RAS in both wild-type (WT) and mutant HRAS/NRAS cells. This interaction was regulated through EGFR-mediated phosphorylation of Y393-AGO2, and utilizing molecular dynamic simulation, we identified a conformational change in pY393-AGO2 protein structure leading to disruption of the RAS binding site. Knockdown of AGO2 led to a profound decrease in proliferation of mutant HRAS/NRAS-driven cell lines but not WT RAS cells. These cells demonstrated oncogene-induced senescence (OIS) as evidenced by β-galactosidase staining and induction of multiple downstream senescence effectors. Mechanistically, we discovered that the senescent phenotype was mediated via induction of reactive oxygen species. We further identified that loss of AGO2 promoted a novel feed forward pathway leading to inhibition of the PTP1B phosphatase and activation of EGFR-MAPK signaling, consequently resulting in OIS. Taken together, our study demonstrates that the EGFR-AGO2-RAS signaling axis is essential for maintaining mutant HRAS and NRAS-driven malignancies. (*PNAS Nexus*. 2022;1(3):pgac084. PubMed PMID: 35923912)

Distinct mutational processes shape selection of MHC class I and class II mutations across primary and metastatic tumors:

Disruption of antigen presentation via loss of major histocompatibility complex (MHC) expression is a strategy whereby cancer cells escape immune surveillance and develop resistance to immunotherapy. Here, we develop the personalized genomics algorithm Hapster and accurately call somatic mutations within the MHC genes of 10,001 primary and 2,199 metastatic tumors, creating a catalog of 1,663 non-synonymous mutations that provide key insights into MHC mutagenesis. We find that MHC class I genes are among the most frequently mutated genes in both primary and metastatic tumors, while MHC class II mutations are more restricted. Recurrent deleterious mutations are found within haplotype- and cancer-type-specific hotspots associated with distinct mutational processes. Functional classification of MHC residues reveals significant positive selection for mutations disruptive to the B2M, peptide, and T cell binding interfaces, as well as to MHC chaperones. (*Cell Reports*. 2023;42(8):112965. PubMed PMID: 37597185)

Genomics driven precision oncology in advanced biliary tract cancer improves survival:

Biliary tract cancers (BTCs) including intrahepatic, perihilar, and distal cholangiocarcinoma as well as gallbladder cancer, are rare but aggressive malignancies with few effective standard-of-care therapies. We implemented integrative clinical sequencing of advanced BTC tumors from 124 consecutive patients who progressed on standard therapies (N=92 with MI-ONCOSEQ and N=32 with commercial gene panels) enrolled between 2011-2020. Genomic profiling of paired tumor and normal DNA and tumor transcriptome (RNA) sequencing identified actionable somatic and germline genomic alterations in 54 patients (43.5%), and potentially actionable alterations in 79 (63.7%) of the cohort.

Of these, patients who received matched targeted therapy (22; 40.7%) had a median overall survival of 28.1 months compared to 13.3 months in those who did not receive matched targeted therapy (32; P < 0.01), or 13.9 months in those without actionable mutations (70; P < 0.01). Additionally, we discovered recurrent activating mutations in FGFR2, and a novel association between KRAS and BRAF mutant tumors with high expression of immune modulatory protein NT5E (CD73) that may represent novel therapeutic avenues. Overall, the identification of actionable / potentially actionable aberrations in a large proportion of cases, and improvement in survival with precision oncology, supports molecular analysis and clinical sequencing for all patients with advanced BTC. (*Neoplasia*. 2023;42:100910. PubMed PMID: 37267699)

Drug Development

PROteolysis TArgeting Chimeric (PROTAC) technology, which hijacks the ubiquitin-proteasome system to degrade a target protein, has become a novel drug discovery paradigm, and small-molecule-based PROTACs have been recently demonstrated to effectively decrease the cellular levels of several protein classes. Recent studies have shown PROTACs to be more efficacious than classic pharmaceutical inhibitors. In collaboration with Drs. Shaomeng Wang (UM), Ke Ding (Shanghai Institute of Organic Chemistry) and others, we reported the development and testing of PROTACs against several therapeutic targets, described briefly below.

ARD-1676 AR PROTAC Degrader:

Extensive characterization of ARD-1676, a highly potent and orally efficacious PROTAC degrader of the androgen receptor (AR) showed that it effectively induces degradation of a broad panel of clinically relevant AR mutants. ARD-1676 effectively reduces the level of AR protein in the VCaP tumor tissue in mice and inhibits tumor growth in the VCaP mouse xenograft tumor model without any sign of toxicity. ARD-1676 is a highly promising development candidate for the treatment of AR+ human prostate cancer. (*Journal of Medicinal Chemistry.* 2023;66(18):13280-303 PubMed PMID: 37683104)

Selective Dual PROTAC Degrader of CDK12 and CDK13:

A series of highly potent and selective dual CDK12/13 degraders were developed by employing PROTAC technology and were evaluated in MDA-MB-231 and MFM223 triple negative breast cancer cell lines. The most potent degrader 7f, potently inhibited cell growth of HR-deficient MFM223 and MDA-MB-436 TNBC cells. *In vivo* studies in the MDA-MB-436 xenografted mouse model demonstrated an efficient degradation of CDK12/13, suggesting the potential advantage of a CDK12/13 degrader for TNBC-targeted therapy as well as other CDK12/13 deficient cancers. (*Journal of Medicinal Chemistry*. 2022;65(16):11066-83. PubMed PMID: 35938508)

PROTAC Degrader of Lipid Kinase PIKfyve:

Earlier, we reported on a phase I-cleared orally bioavailable MTKI, ESK981, with a novel autophagy inhibitory property that decreased tumor growth in diverse preclinical models of CRPC. Further, we identified the lipid kinase PIKfyve as the direct target of ESK981. PIKfyve-knockdown recapitulated ESK981's anti-tumor activity and enhanced the therapeutic benefit of immune checkpoint blockade. Recently, we published on the discovery of the first series of PIKfyve PROTAC degraders. The optimal compound 12d (PIK5-12d) showed potent degradative activity against PIKfyve in prostate cancer VCaP cells. It also exhibited promising PIKfyve degradative effects *in vivo*. Importantly, PIK5-12d exerted prolonged inhibition of PIKfyve downstream signaling and outperformed the parent PIKfyve inhibitor in the suppression of the growth of prostate cancer cells. (*Journal of Medicinal Chemistry*. 2023;66(17):12432-45. PubMed PMID: 37605297)

Molecular Pathology – Biomarkers/Assay Development

The MCTP Molecular Pathology group led by Dr. Rohit Mehra, utilizes various cutting-edge techniques to identify and characterize novel diagnostic biomarkers in genitourinary malignancies and renal cell cancers and apply the findings to develop clinical assays. The group has published several recent manuscripts reporting on biomarker and assay development.

Clinical TFE3/TFEB FISH assays in renal cell carcinoma (RCC) suspicious for MiTF family aberrations:

We reviewed 801 clinical TFE3/TFEB FISH assays performed at our tertiary-level institution between 2014 and 2023 on kidney tumors suspicious at the morphologic or biomarker level for MiTF aberrations and summarized and analyzed clinical information, TFE3/TFEB FISH results, and available biomarker staining results in a cohort of 453 consecutive kidney tumor cases suspicious for MiTF-RCC. Clinical TFE3/TFEB FISH assays successfully identified and confirmed rare MiTF-RCC with TFE3 and TFEB rearrangements. Although morphologic and biomarker features associated with a kidney tumor may be suggestive of MiTF-RCC, clinical TFE3/TFEB FISH assays are crucial for a confirmation and definitive subclassification of patients with MiTF-RCC. (*American Journal of Clinical Pathology*. 2023. Epub 2023/07/27. doi: 10.1093/ajcp/aqad089. PubMed PMID: 37499055)

Characterization of protein 2SC succination as a biomarker for FH-deficient renal cell carcinoma:

We carried out biomarker characterization and performance of 2SC expression by immunohistochemistry (IHC) in FH-deficient RCC and other common and rare RCC subtypes. Morphological assessment revealed characteristic cytomorphologic features and a majority (55%) of FH-deficient RCC had mixed architectural growth patterns. Our findings along with the prior evidence in literature support the utilization of 2SC as a positive marker, along with the loss of FH expression by anti-FH IHC staining as a negative marker, in clinical and/or pathologic scenarios when considering FH-deficient RCC in the differential diagnosis. FH-/2SC+ may serve as a comprehensive IHC panel in identifying such cases and excluding morphologically similar entities. (*Hum Pathol*. 2023;134:102-13. PubMed PMID: 36581128)

KIT and LINC01187 biomarkers in Chromophobe Renal Cell Carcinoma and Other Renal Neoplasms:

In a recent NGS-based study, we nominated a lineage-specific novel biomarker LINC01187 (long intergenic non-protein coding RNA 1187) which was found to be enriched in chromophobe RCC. Like KIT (cluster of differentiation 117; CD117), a clinically utilized chromophobe RCC related biomarker, LINC01187 is expressed in intercalated cells of the nephron. Here, we performed KIT immunohistochemistry and LINC01187 RNA in situ hybridization (RNA-ISH) on a cohort of chromophobe RCC and other renal neoplasms and characterized the expression patterns and quantified the expression signals of the two biomarkers in both primary and metastatic settings. LINC01187, in comparison to KIT, exhibits stronger and more uniform expression within tumors while maintaining temporal and spatial consistency. LINC01187 also is devoid of intra-tumoral heterogeneous expression pattern, a phenomenon commonly noted with KIT. LINC01187 expression can augment the currently utilized KIT assay and help facilitate easy microscopic analyses in routine surgical pathology practice. (*International Journal of Surgical Pathology*. 2023;31(6):1027-40. PubMed PMID: 36250542)

Highly Recurrent IDH1 Mutations in Prostate Cancer:

We studied a cohort of 4 unique prostate cancers characterized by intratumoral psammomatous calcification-which we have termed prostate cancer with psammomatous calcification (PCWPC). Clinicopathologic review demonstrates that PCWPCs are high-grade (grade group ≥3) tumors that involve the anterior prostate, and integrative targeted next-generation sequencing reveals recurrent hotspot IDH1 mutations. Our findings suggest that PCWPC represents a novel subtype of prostate cancer enriched for an anterior location and the presence of hotspot IDH1 mutations. Recognition of these unique morphologic features could help identify IDH1-mutant prostate cancer cases retrospectively, and prospectively facilitating future large research studies and enabling clinical trial enrollment and precision medicine approaches for patients with advanced and/or aggressive disease. (*Modern Pathology*. 2023;36(6):100146. PubMed PMID: 36828361)

Clinical Proteomic Tumor Analysis Consortium Studies

In collaboration with the NCI's Clinical Proteomic Tumor Analysis Consortium (CPTAC), the UM team was involved in several major published studies. These studies yield valuable resources for the research community as well.

Proteogenomic Data and Resources for Pan-cancer Analysis:

To facilitate pan-cancer investigations, CPTAC investigators generated harmonized genomic, transcriptomic, proteomic, and clinical data for >1,000 tumors in 10 cohorts to create a cohesive and powerful dataset for scientific discovery. (*Cancer Cell*. 2023;41(8):1397-406. PubMed PMID: 37582339)

Pan-cancer Proteogenomics Connects Oncogenic Drivers to Functional States:

Multi-omics pan-cancer analysis by CPTAC team uncovered insights into the impacts of cancer drivers by identifying their significant cis-effects and distal trans-effects quantified at the RNA, protein, and phosphoprotein levels. The data uncovered association of point mutations and copy-number alterations with the rewiring of protein interaction networks, and notably, most cancer genes converge toward similar molecular states denoted by sequence-based kinase activity profiles. A correlation between predicted neoantigen burden and measured T cell infiltration suggested potential vulnerabilities for immunotherapies. Overall, this work demonstrated the value of comprehensive proteogenomics in understanding the functional states of oncogenic drivers and their links to cancer development, surpassing the limitations of studying individual cancer types. (*Cell.* 2023;186(18):3921-44.e25. PubMed PMID: 37582357)

Histopathologic and Proteogenomic Heterogeneity of ccRCC:

Clear cell renal cell carcinomas (ccRCCs) represent ~75% of RCC cases and account for most RCC-associated deaths. To obtain the most comprehensive profile of ccRCC, integrative histopathologic, proteogenomic, and metabolomic analyses was carried out on 305 ccRCC tumor segments and 166 paired adjacent normal tissues from 213 cases. Combining histologic and molecular profiles revealed ITH in 90% of ccRCCs, with 50% demonstrating immune signature heterogeneity. High tumor grade, along with BAP1 mutation, genome instability, increased hypermethylation, and a specific protein glycosylation signature define a high-risk disease subset, where UCHL1 expression displays prognostic value. Single-nuclei RNA sequencing of the adverse sarcomatoid and rhabdoid phenotypes uncovered gene signatures and potential insights into tumor evolution. *In vitro* cell line studies confirm the potential of inhibiting identified phosphoproteome targets. This study molecularly stratifies aggressive histopathologic subtypes that may inform more effective treatment strategies. (*Cancer Cell*. 2023;41(1):139-63. e17. PubMed PMID: 36563681)

Therapeutic Targeting of SARS-CoV-2

Antisense oligonucleotides to therapeutically target SARS-CoV-2 infection:

There remains a critical need for development of novel therapeutics against SARS-CoV-2. One technology that has remained relatively unexplored in COVID-19 is the use of antisense oligonucleotides (ASOs)-short single-stranded nucleic acids that bind to target RNA transcripts to modulate their expression. In this study, ASOs targeted against the SARS-CoV-2 genome and host entry factors, ACE2 and TMPRSS2, were designed and tested for their ability to inhibit cellular infection by SARS-CoV-2. Using our previously developed SARS-CoV-2 bioassay platform, we screened 180 total ASOs targeting various regions of the SARS-CoV-2 genome and validated several ASOs that potently blocked SARS-CoV-2 infection *in vitro*. Our results support further research into the development of ASOs targeting SARS-CoV-2 and host entry factors as potential COVID-19 therapeutics. (*PloS One*. 2023;18(2):e0281281. PubMed PMID: 36735698)

Proxalutamide reduces SARS-CoV-2 infection and associated inflammatory response:

Early in the COVID-19 pandemic, data suggested that males had a higher risk of developing severe disease and that androgen deprivation therapy might be associated with protection. Proxalutamide, an AR antagonist, was shown in initial clinical studies to benefit COVID-19 patients; however, further validation is needed as one study was retracted. Due to continued interest in proxalutamide, which is in phase 3 trials, we examined its ability to impact SARS-CoV-2 infection and downstream inflammatory responses. Proxalutamide inhibited infection by multiple SARS-CoV-2 variants and synergized

with remdesivir. Proxalutamide protected against cell death in response to tumor necrosis factor alpha and interferon gamma, and overall survival of mice was increased with proxalutamide treatment prior to cytokine exposure. Mechanistically, we found that proxalutamide increased levels of NRF2, an essential transcription factor that mediates antioxidant responses, and decreased lung inflammation. These data provide compelling evidence that proxalutamide can prevent SARS-CoV-2 infection and cytokine-induced lung damage, suggesting that promising clinical data may emerge from ongoing phase 3 trials. (*PNAS*. 2023;120(30):e2221809120. PubMed PMID: 37459541)

Urine Assays

MyProstateScore in men considering repeat biopsy: validation of a simple testing approach:

Our previously developed and validated MyProstateScore (MPS) test is clinically available for pre-biopsy risk stratification. Here, we established a practical MPS-based testing approach in men with a previous negative biopsy being considered for repeat biopsy. We showed that use of MPS >40 to rule-in biopsy would have prevented 67% of biopsies while maintaining 95% negative predictive value. In patients who previously underwent a negative prostate biopsy, the MPS values of 15 and 40 yielded clinically actionable rule-in and rule-out risk groups. Using this straightforward testing approach, MPS can meaningfully inform patients and physicians weighing the need for repeat biopsy. (*Prostate Cancer and Prostatic Diseases*. 2023;26(3):563-7. PubMed PMID: 36585434)

Clinical Activities

To exploit the rapid advances in high-throughput DNA sequencing technologies to realize the goals of "precision cancer medicine," we established the Michigan Oncology Sequencing Center (MI-ONCOSEQ) in 2011 (Roychowdhury et al, 2012). An "integrative sequencing approach" carried out in a CLIA-certified laboratory (#23D0366712) is utilized to provide a comprehensive landscape of the genetic alterations in individual tumor specimens for the purpose of identifying informative and/or actionable mutations. This approach enables the detection of point mutations, insertions/deletions, gene fusions and rearrangements, amplifications/deletions, and outlier expressed genes. Furthermore, we can identify certain germline alterations that may also be relevant. We continue to develop novel approaches for clinical sequencing and broadening the application of sequence data towards predicting response to immunotherapy and determination of epigenetic status. Thus far we have sequenced samples from over 6,500 adult and pediatric patients; a breakdown of the major cohorts for whom results are returned in the form of a molecular report is listed in the table below.

Cohort	Total Patients Enrolled	Patients Enrolled FY23
MO- (MiOncoseq)	1,781	49
TP- (Tumor Profiling)	1,026	54
PO- (Peds Oncoseq)	975	101
MMRF- MyDrug	205	25
VA - (PCF-VA)	270	65
BT – (Biliary Tract)	230	30
Total	**4,487**	**324**

Additionally, our sequencing facility supports a number of specialized programs and clinical studies. We have continued our contract with the Multiple Myeloma Research Foundation into the next phase, MyDrug, that selects patients for therapies/trials based on their sequencing results. We also serve as the sequencing center for the VA - PCF POPCAP program to comprehensively evaluate samples from veterans with metastatic prostate cancer in an effort to provide them access to better and less toxic therapy through targeted therapy.

Program	FY22 Revenue	FY23 Revenue	2024 Projected Revenue
MMRF	$136,389.00	$116,317.00	$50,000
VA/PCF	$254,000.00	$109,200.00	$150,000

MI-ONCOSEQ has been supporting several ongoing clinical trials/

studies, listed in table below (charges based on select cases chosen for sequencing). We have enrolled 981 total patients to date collectively through all studies. *(See Appendix, pg. 85)*

The MCTP Histopathology team assists in the processing and evaluation of submitted specimens for frozen and formalin-fixed biopsy samples from metastatic carcinoma at various sites. Slides are processed at a state-of-the-art CLIA-certified histology lab. This lab provides exclusive support to the Michigan Prostate SPORE, the MiOncoSeq sequencing program, and over 15 clinical trials; volumes of slides prepared for these translational studies with a heavy focus on prostate cancer are represented below.

In association with MLabs, MCTP's Molecular Testing Lab (MTL) receives orders for and carries out PCA3, Mi-Prostate Score (MPS), and to a smaller extent, Cell Search Circulating Tumor Cell (CTC) assays. Since 2010, MTL has processed a total of 17,205 PCA3, 1,989 MPS and 1,757 CTC assays for clinical use. Additionally, 3,281 PCA3 and 3,281 MPS assays have been processed for research samples. In July 2022, PCA3 and MPS tests were discontinued by Hologic. Tests were transferred to LynxDx for Open Array platform. The lab provided >1,000 samples for validation and 45 CTC were performed in FY23.

MTL also procures biological samples such as urine, blood, and tissue for ongoing clinical and research projects. Since 2010 MTL has procured 2,016 tissue, 6,164 Urine, 5,609 serum and 5,601 EDTA plasma samples.

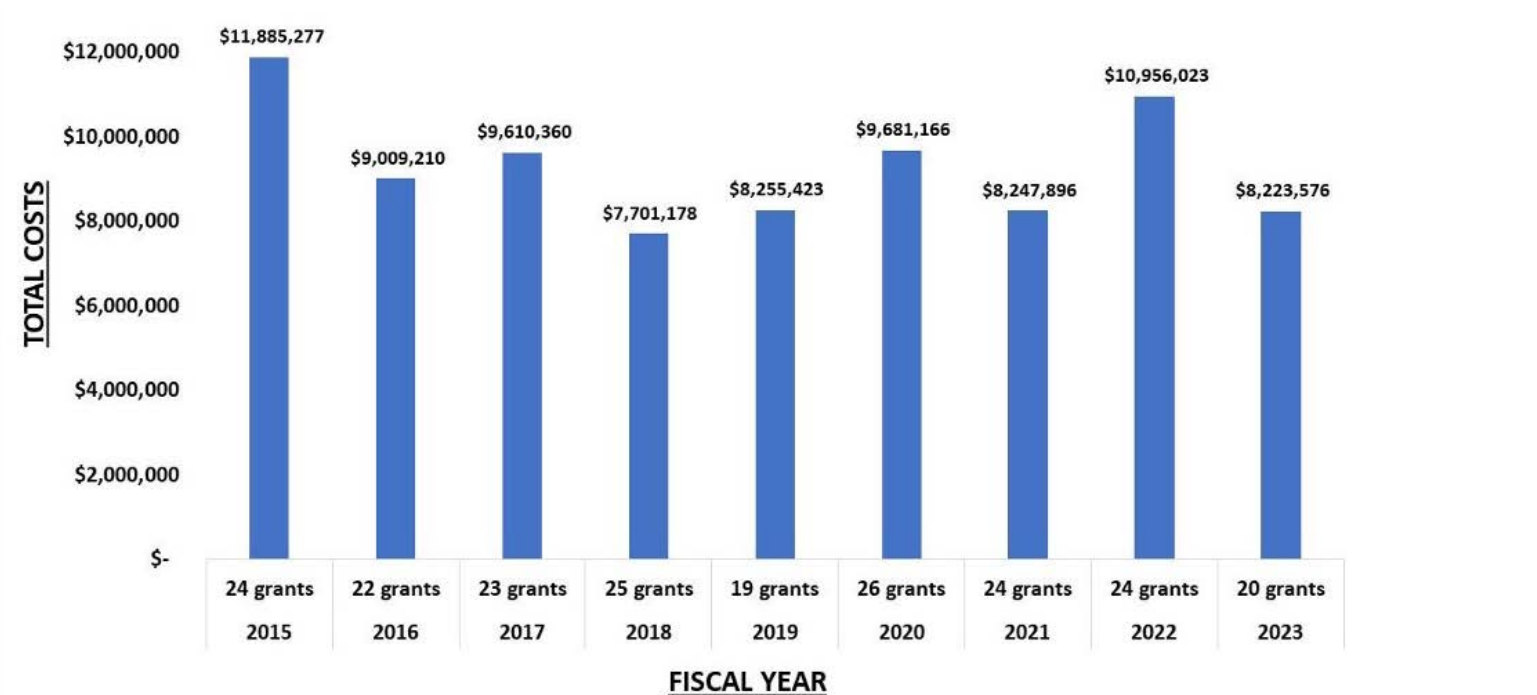
MTL supports the MiOncoSeq sequencing program and working closely with the MI Prostate SPORE Biospecimen core, supports the following clinical studies and research projects:

- **HUM00148970:** EDRN Prostate MRI Biomarker Study and Reference Set (13 Sites)
- **HUM00117711:** Targeted Early Detection Program in Men at High Genetic Risk for Prostate Cancer
- **HUM00086525:** Biomarkers and clinical parameters associated with Gleason score upgrading
- **HUM00188437:** Interstitial assessment of architectural heterogeneity in prostate cancer ex vivo
- **HUM00197931:** Prospective study to evaluate MPS-NGS urine assay for predicting grade progression in men on active surveillance for prostate cancer
- **UMCC 2021.046:** A phase II randomized trial of moderate versus ultra-hypofractionated post-prostatectomy radiation therapy
- **20CHAL03: PC-REACTR:** A Multidimensional Tumor Atlas to Overcome Prostate Cancer Therapy Resistance
- **P20CA26735-01:** Reducing Cancer Health Disparities in Detroit
- **PC200234:** Integrative molecular profiling of whole urine in African American men with aggressive prostate cancer
- **KCI 2017-110:** Feasibility Study of MicroRNA Biomarkers and MRI Guided Fusion Biopsy in Prostate Cancer
- **ARV-110-mCRPC-101:** A Phase I/II, Open-Label, Dose Escalation of Cohort Expansion Clinical Trial to Evaluate the Safety, Tolerability, Pharmacokinetics, and Pharmacodynamics of ARV-110 in Patients with Metastatic Castration-Resistant Prostate Cancer
- **ARV-766-mCRPC-101:** A Phase I/II Open-Label, Dose-Escalation and Cohort Expansion Clinical Trial to Evaluate the Safety, Tolerability, Pharmacokinetics, and Pharmacodynamics of ARV-766 in Patients with Metastatic Castration-Resistant Prostate Cancer
- **ORIC-944-01:** An Open-Label, Phase 1/1b, Study of ORIC-944 in Patients with Metastatic Prostate Cancer
- **AC176-001:** A Phase I, Open-label, Multi-center, Clinical Study to Evaluate Safety, Tolerability, Pharmacokinetics, Pharmacodynamics, and Preliminary Anti-Tumor Activity of AC176 in Patients with Metastatic Castration-Resistant Prostate Cancer Who Have Progressed on at Least Two Prior Systemic Therapies
- **PETRANHA:** A Multi-arm, Open-label Phase I/IIa Study to Assess the Safety, Tolerability, Pharmacokinetics, Pharmacodynamics and Preliminary Efficacy of AZD5305 in Combination with New Hormonal Agents in Patients with Metastatic Prostate Cancer
- **CES-0005 Symphony™ Clinical Trial:** IL-6 for COVID-19 Patients sponsored by Bluejay Diagnostics, Inc.

The Core also supports researchers who are utilizing a novel targeted next-generation sequencing (NGS) method to profile urine-extracted RNA from men undergoing prostate biopsy, and we have recently validated a novel high-throughput method of extracting RNA from small amounts of post-DRE urine for various molecular analyses. Similarly, we have novel prostate cancer-focused targeted NGS assays available for profiling tissue-extracted DNA and RNA from prostate cancer tumor specimens, including formalin-fixed paraffin-embedded (FFPE) clinical biospecimens.

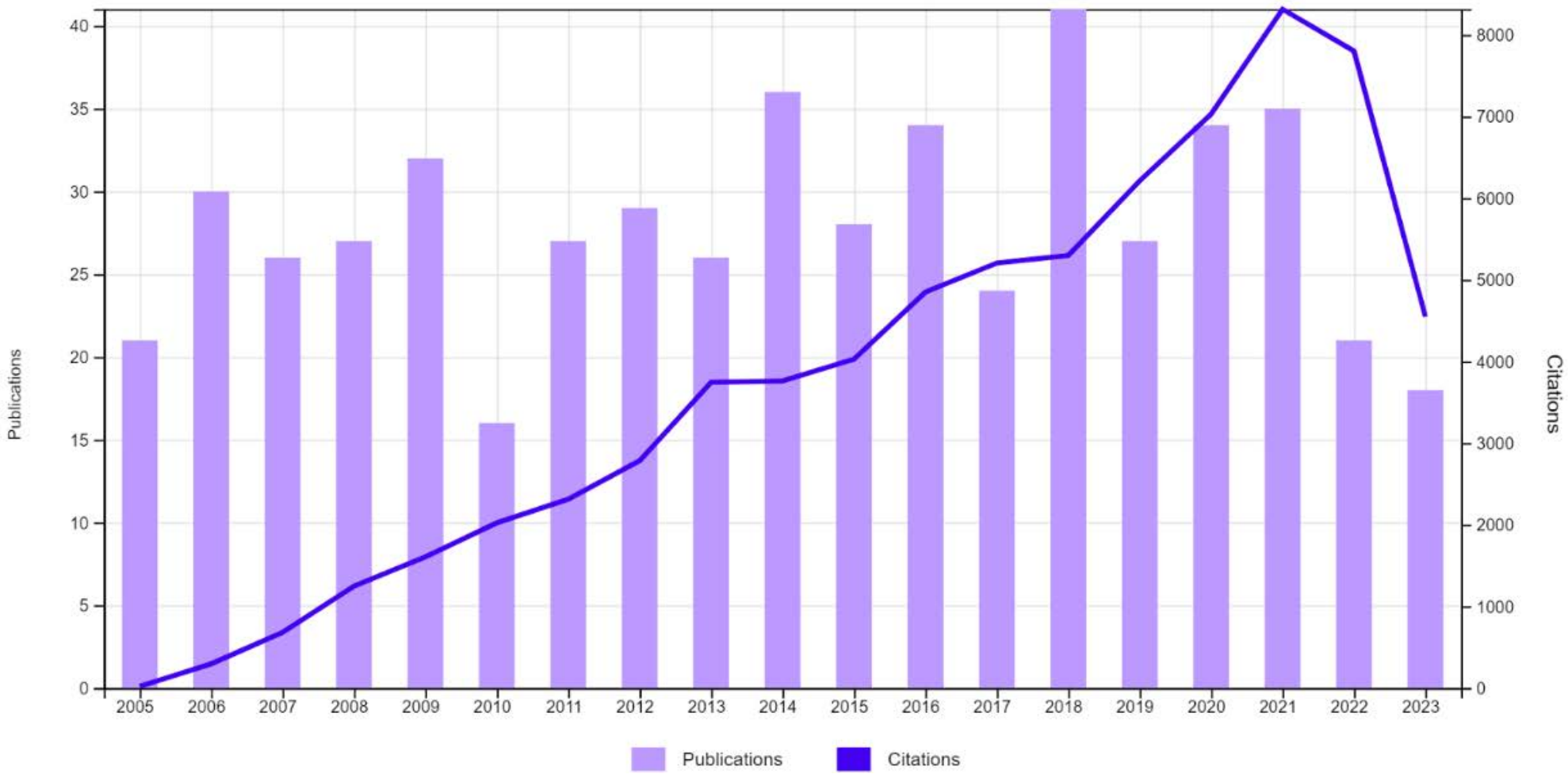
Academic Activities

Total number of publications in FY23
Overall, Dr. Chinnaiyan authored 39 publications in FY23, including in high-impact journals (*Cell*; *PNAS*) and MCTP faculty collectively published 141 papers in (all Core Faculty not including Chinnaiyan). Our publications are highly cited with an overall H-index of 142 for Dr. Chinnaiyan (Web of Science®).



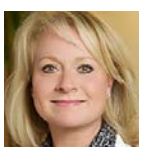
Total Number of Grants Held

Including the total dollar value of the grants over the last 7 years



Michigan Medicine Laboratories (MLabs)

Jeffrey L. Myers, MD
Director, MLabs Reference Laboratory



Julia Dahl, MD
Associate Director, MLabs Reference Laboratory

MLabs is the Department of Pathology's full-service reference laboratory that leverages the combined strengths of our faculty, trainees, staff, and state-of-the-art laboratories. We value our vital role as the conduit that allows access for patients around the world to Michigan Medicine expertise. With Michigan Medicine's advancing our statewide network of care to further strengthen programs with UMH-West and with the acquisition of Sparrow Health System, MLabs leveraged our lengthy relationships with both facilities to begin the exploration of laboratory integration as a system. Whether with our affiliates or clients from around the globe, we strive to be a trusted partner to all, building strong relationships with pathologists, hospital laboratories, skilled nursing facilities, physician offices, and specialty physicians across Michigan and the nation. Our highly effective collaborations put the needs of the patient at the top of all we do, aligning us strongly with the Michigan Medicine mission "To advance health to serve Michigan and the world."

Operations FY23

How MLabs demonstrates dedication to providing high quality laboratory services built on delivering expertise personally expanded during FY23. MLabs assumed responsibility for additional pre-analytical and post-analytical services, led by Deirdre Fidler. This involved recruitment of seven new team members to provide services in consultation receiving and processing. Two process improvement projects to create efficiency and safety were successfully deployed in this area in collaboration with personnel across the department and with Michigan Medicine's Quality Division. MLabs also successfully gained approval for five newly created positions that will focus on more rapid deployment of test order and result interfaces for our clients. These positions will be fully trained and providing services by the conclusion of FY24 making MLabs more agile in advancing Michigan Medicine's statewide care initiatives and serving our national clients. During these periods of marked transition and increasing responsibility, MLabs personnel in other work units provided cross coverage to ensure that services gaps for patients and providers would be avoided.

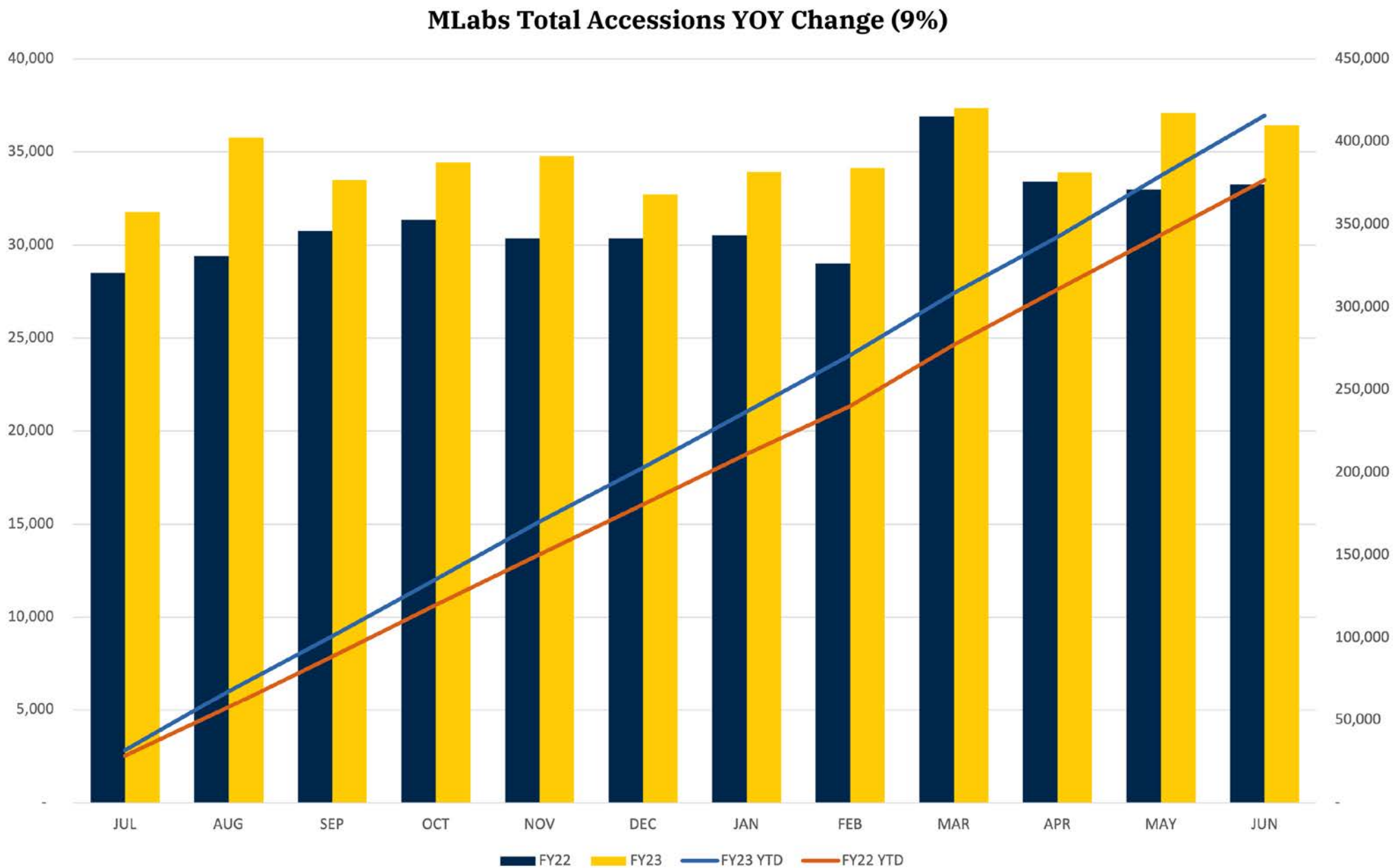
Business Development

Throughout FY23, our sales and marketing team, led by Karla Bialk and Kelly LaBarge, continued to refine and began rolling out the territory management initiative intended to better serve our clients whether local, regional, or national. To serve "internal" clients, regular interdivisional meetings to forecast shifts in MLabs work likely to impact our laboratories and other integrated activities while also learning about changes in laboratory staffing, test menu, and technology changes with the potential to impact our clients continued.

The MLabs Business Development team returned to primarily in-person presence and participated in or exhibited at conferences relevant to reference laboratory medicine and in support of our faculty. During FY23, MLabs exhibited at College of American Pathologists (October 2022), Association for Molecular Pathology (November 2022); American Society for Clinical Pathology (November 2022); Texas Society of Pathologists (January 2023) Florida Society of Pathologists (February 2023); United States and Canadian Academy of Pathology (March 2023), Executive War College (April 2023); Commission on Office Laboratory Accreditation (May 2023), and American Society of Clinical Oncology (June 2023).

Transition in MLabs Leadership

The end of FY23 brought a significant transition for MLabs, while we celebrated twelve years of service provided by Jeffrey L. Myers, MD, our Medical Director. A dinner in his honor was hosted following the close of the fiscal year, with participation


MLabs Total Accessions YOY Change (9%)
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
-
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
-
JUL
AUG
SEP
OCT
NOV
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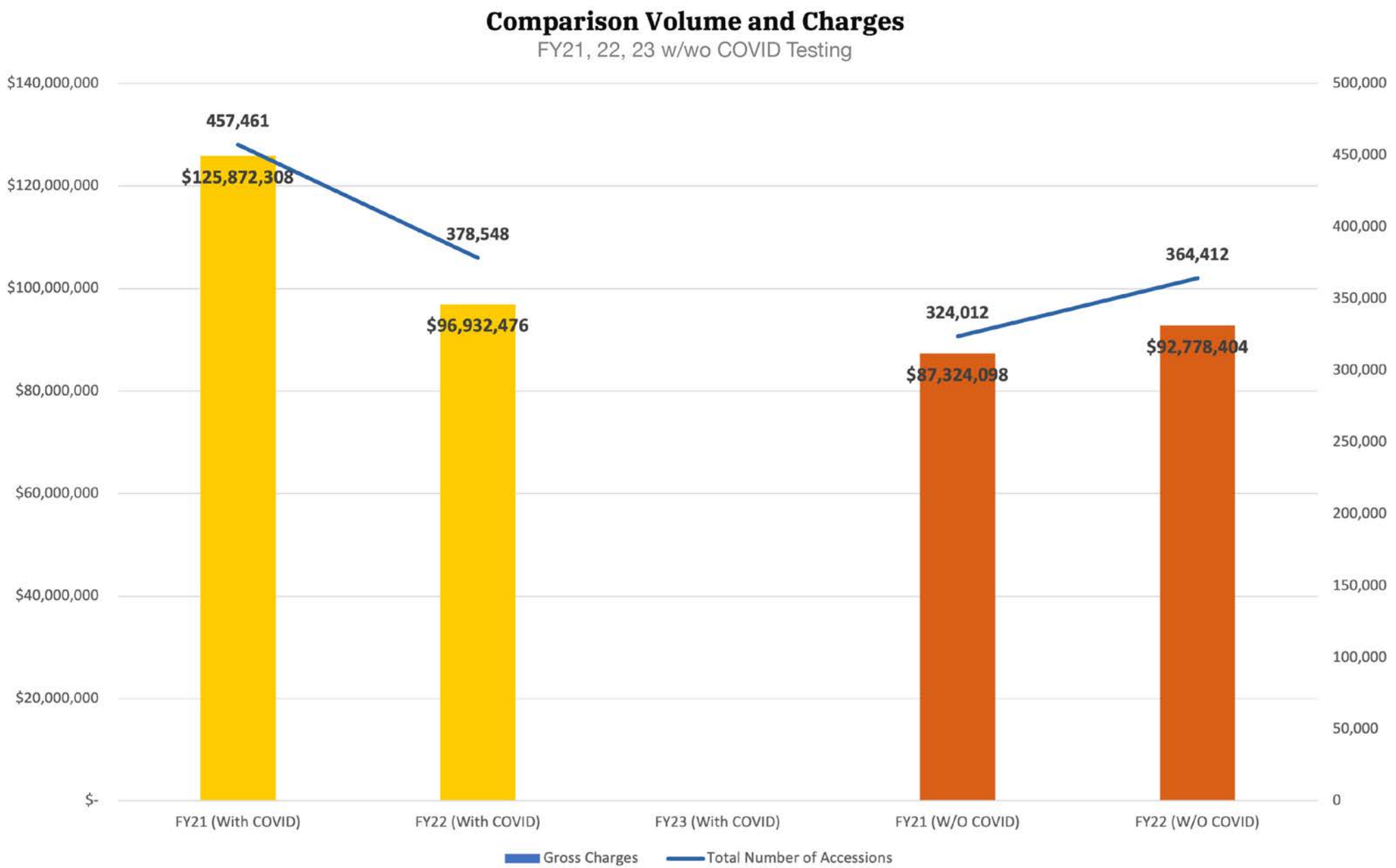
JAN
FEB
MAR
APR
MAY
JUN
FY22
FY23
FY23 YTD
FY22 YTD


Comparison Volume and Charges
FY21, 22, 23 w/wo COVID Testing
$140,000,000
$120,000,000
$100,000,000
$80,000,000
$60,000,000
$40,000,000
$20,000,000
$-
500,000
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
457,461
$125,872,308
378,548
$96,932,476
324,012
$87,324,098
364,412
$92,778,404
FY21 (With COVID)
FY22 (With COVID)
FY23 (With COVID)
FY21 (W/O COVID)
FY22 (W/O COVID)
Gross Charges
Total Number of Accessions

from Michigan Medicine leadership and Department leaders and colleagues from distant places – to show gratitude for the remarkable growth and success that MLabs gained under Dr. Myers' leadership. As we turn to FY24, Dr. Julia Dahl, previously MLabs Associate Director, begins her journey leading MLabs building upon the successes of the past and forging forward into new complexity and new opportunities.

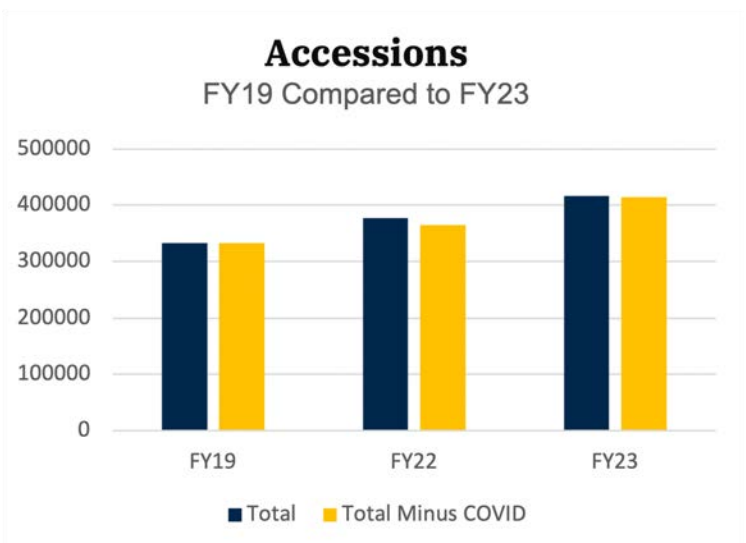
Volume of Referrals

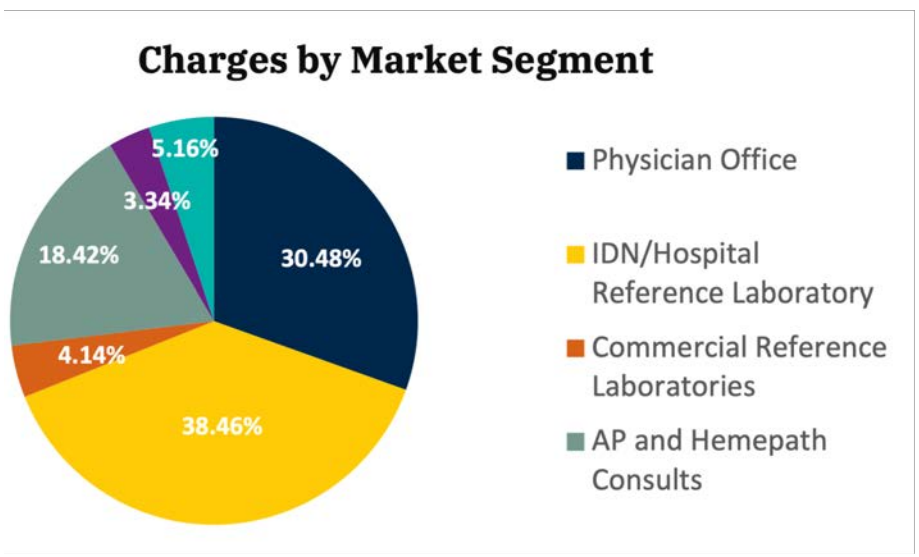
Total activity showed year-over-year growth of 9% measured as total number of accessioned cases (415,852) and 6% measured as total billable tests (603,176). Total gross charges grew at an annual rate of 2% compared to FY22, showing sustained growth over the year. This continues a trend toward positive growth curves over the last five years; from FY19 to FY23, gross charges increased 21.7%.

Anatomic and hematopathology consultations through MLabs exceeded 21,200 referrals of the most complex and challenging cases viewed by pathologists nationwide. This is an 11% growth over FY22 and continues to support the robust subspecialty fellowships offered by the Department of Pathology.

Total Gross Charges by Market Segment

MLabs continues to support a diverse portfolio of clients. Integrated Delivery Network Reference Laboratory, Commercial Reference, Anatomic and Hematopathology Consultations to Hospital and other pathology groups, and "Other" clients demonstrated significant growth, which offset the decreased volume and revenue seen in the Physician Office and Skilled Nursing Facility market segments. IDN Reference Laboratory business continued to maintain the largest share of MLabs related charges (39%), followed by Physician Office (31%), AP and Hemepath Consultations (18%), Other (5%), Commercial Reference Laboratories (5%), and Skilled Nursing Facilities (3%).





Veterans Affairs Pathology & Lab Medicine

Darius Amjadi, MD, JD
Chief of Pathology and Laboratory Services,
Veteran's Administration Hospital Laboratories, VA

The Pathology and Laboratory Medicine Service of the Veterans Affairs Healthcare System, in Ann Arbor, Michigan, is staffed by pathologists with a joint appointment at the University of Michigan Medical School. The VA Ann Arbor is a designated cancer center providing regional full-service clinical laboratory testing. They support Anatomic Pathology services in Centers in Battle Creek, Saginaw, Detroit, and Northern Indiana. In addition, chemistry and hematology testing is offered at our Toledo, Ohio laboratory, and point-of-care testing is offered in Flint and Jackson, Michigan community outpatient clinics. The data presented is for calendar year 2022.

The Pathology and Laboratory Medicine Service (PALMS) has a comprehensive program of quality management varying from short-term problem directed studies to long-term continuous monitoring. The Quality Management Plan is designed to oversee all the functions and operations of PALMS based on the application of the Quality Systems Essentials (QSE). Activities occurring in FFY22 are included below.

Organization, Leadership, Personnel Management

Position changes and updates:

- Molecular Diagnostics Section validating new testing for Mycoplasma genitelium and Trichomonas vaginalis on the Roche Cobas 6800.
- Additional new 1200-2000 micro/molecular hybrid position created to assist with COVID workload and microbiology/ molecular specimen set-up.
- Further work in progress with implementation of new Cerner system.
- Fully live with new CBOCS in the Ann Arbor Healthcare designation at Howell, Canton, and Adrian.
- In-House testing brought on-board: Full Implementation of new Molecular department.
- Testing for Battle Creek specimens are done in Ann Arbor's Molecular Department.
- Returned Toledo VA Lab back to pre-staffing shortage testing levels.
- Hit 85% response in all employee survey.

The VHA establishes high standards of quality and timeliness. Laboratory faculty and staff work hard to meet these standards, meeting clinical pathology STAT specimen turnaround time goals of 95% in all sections, except Chemistry, which met goals 92.5% of the time. Our outpatient phlebotomy team serviced 66.7% of patients in less than 10 minutes due to short staffing, but satisfaction surveys indicated 95% of patients were satisfied with their service.

In Anatomic Pathology, the VHA has established a target of >95% concordance rate between frozen section diagnosis and permanent section diagnosis. In FFY22, concordance missed the target slightly at 92.92%, down from 94.42% the prior year.

Aspect of Care: Accuracy of Anatomic Pathology Diagnoses

Invasive Procedure Reports **Oct. 1, 2021 - Sept. 30, 2022**	**FY21**	**FY22**
Total cases with Frozen Sections (FS)	160	130
Total Number of FS	381	284
FS with Permanent Sections (Agreement)	374	264
Diagnosis Deferred on FS	1	0
FS with Permanent Sections (Disagreement)	6	2
% Concordance	94.42%	92.92%

The Invasive Procedures Committee reviews surgical cases to determine the appropriateness of the invasive procedure based on the pathologic findings. This is an important interservice monitor. Of the more than 12,400 cases reviewed, 98.83% were found to be clinically indicated with significant pathologic changes found. However, 140 cases, 1.13%, were not coded. This is an area which will continue to be monitored for compliance.

Invasive procedure
Oct. 1, 2021 - Sept. 30, 2022

TC Code	Count	Accessions
I, Proc. Clinically indicated, Significant Pathology Present	12,248	98.83%
IIA, Procedure clinically indicated. No pathologic changes.	5	0.04%
IIB, Clinically unexpected lesion.	0	0%
IIC, Pathologic lesion could be diagnosed by less invasive procedure.	0	0%
III, No significant abnormality present. Procedure not indicated.	0	0%
None	140	1.13%
Total	**12,393**	

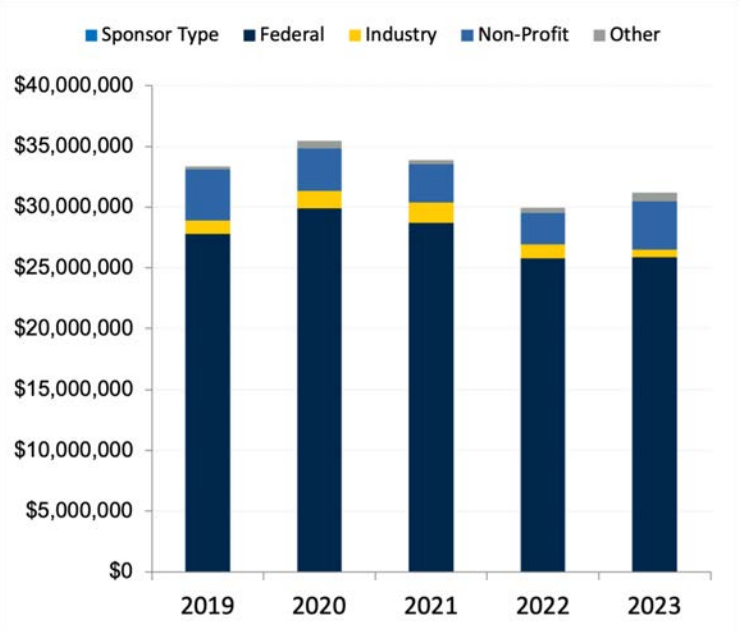
In 2022, eight random cases were selected for 5-year PAP review. The original diagnosis was confirmed in 100% of the cases. In addition 10% of surgical pathology specimens were reviewed. Reviewers found a 99.37% full agreement concordance and 0.63% minor disagreement in the diagnoses. No major disagreements were found.

Research Mission

Asma Nusrat, MD
Director, Experimental Pathology

Experimental Pathology faculty have enjoyed yet another highly successful year. Experimental faculty occupy ~65,600 sq. ft. of research space in numerous buildings across the medical campus. The research focus is diverse and spans a wide spectrum of cancer biology, inflammation and immune response, genetics, and aging. Results emanating from the division are at the forefront of cutting-edge research that bridges new basic discoveries with the clinical practice of medicine. Discoveries have been in basic biology, disease pathogenesis, and therapeutics. The success of this division is further evidenced by outstanding grant funding, high-impact publications, patents, and prestigious faculty awards. *(See list of Inventions in Appendix pg. 85)*

EP faculty have successfully procured substantial research grant funding in the previous academic year, amounting to an impressive $30,994,979. Most of this funding was granted by federal sources which include the National Institutes of Health (NIH) and Department of Defense (DoD), supplemented by funding from foundations and industry (as shown to the right). This remarkable achievement is demonstrated through awards that include 55 NIH grants (R01 to R37 grants and subcontracts), 10 Department of Defense research grants, and 36 grants awarded by foundations and industry. We have 8 subcontracts for NIH grants (T32, UO1, U24, U2C). When evaluated at a national level, we have the fifth highest number of R01 grants awarded to experimental pathology faculty. With inclusion of other federal grant dollar amounts, we have been ranked as seventh in the nation. These statistics underline the high productivity of our Experimental Pathology faculty, which is commendable considering the rigorous and competitive nature of the national grant funding landscape. Furthermore, our EP faculty continues to demonstrate outstanding mentorship, as evidenced by the research fellowship and career development grants awarded to the trainees. Consequently, the grant indirect costs of our department are high in the overall University of Michigan



Medical School. Given this achievement, EP faculty maintain an impressive average research space dollar density that on average exceeds $168 per square foot. AP/CP clinical faculty have collaborated on numerous grant-funded projects which is also a testament to the cohesive research and clinical environment in pathology. The innovative and research successes of our EP faculty are further illustrated by their substantial intellectual properties, which include 33 patent applications, 9 granted patents, 22 new invention reports, and 2 new license/option agreements.

Continuing their excellence across academic responsibilities, EP faculty members have contributed to educating medical and graduate students and participated in and led institutional,

national, and international committees and seminars. These outstanding contributions have included EP faculty participation in research grant review panels, scientific seminars, editorial boards, and national/international meetings and are a testament to faculty dedication to academics.

Our chairperson, Dr. Charles Parkos, continues his dedicated service as a board member for the Federation of American Societies for Experimental Biology (FASEB) member societies. As part of his role, he has continued to advocate for the importance of scientific funding to congressional members in Washington, DC. Dr. Gabriel Nuñez is a member of the Biomedical Scholar Program committee and has played an important role in recruiting highly talented and promising young researchers to the University of Michigan Medical School. Dr. Thomas Wilson, as the faculty director of the Advanced Genomics Core, plays a vital role in securing and facilitating cutting-edge genomics and single-cell sequencing technology for medical school researchers. In the Rogel Cancer Center, Dr. Kathleen Cho co-leads the Cancer Genetics Program, and Dr. Jolanta Grembecka jointly oversees Development Therapeutics. These respected roles contribute significantly to the advancement of research and treatment discovery efforts at our institution. EP faculty have received many prestigious institutional/national and international awards some of which are highlighted below:

- Richard Miller – Geriatrics Center and Department of Pathology Distinguished Scientist Award
- Tomasz Cierpicki – 2022 Rogel Scholar, Rogel Cancer Center
- Jolanta Grembecka – Richard and Susan Rogel Professor in Cancer Therapeutics, UM
- Celina Kleer – 2022 Rogel Scholar, Rogel Cancer Center
- Rajesh Rao – Career Advancement Award, Research to Prevent Blindness; Secretariat Award, American Academy of Ophthalmology; Valuing Our Own Award, UMMS
- Alexey Nesvizhskii – The Distinguished Achievement in Proteomic Sciences Award, International Human Proteome Organization; Inaugural Godfrey Dorr Stobbe Professor in Bioinformatics
- Kathleen Cho – Rosalind Franklin Excellence in Ovarian Cancer Research, Ovarian Cancer Research Alliance
- Charles Parkos – Fellow American Association for the Advancement of Science
- Asma Nusrat – Fellow, American Association for the Advancement of Science and the Rous Whipple Award from the American Society for Investigative Pathology

In addition to numerous EP faculty leadership roles, new appointments have included the following:

- Sriram Venneti – Scientific Director of the Chad Carr Pediatric Brain Tumor Center as well as the Director of Faculty Development and Recruiting in Experimental Pathology
- Aaron Udager – Associate Director of the Pathology Physician Scientist Training Program
- Simon Hogan and Jeff Rual – Co-Directors, Molecular and Cellular Pathology (MCP) Graduate Program
- Evan Keller – Director of Research Cores, OVPR
- Zaneta Nikolovska-Coleska – Associate Dean for Graduate Medical Education, UMMS and at the National level, president and member of the board of directors for the International Chemical Biology Society
- Thomas Wilson - Chair, Genomics and Data Sciences Special Interest Group (SIG), Environmental Mutagenesis and Genomics Society (EMGS)
- Evan Farkash– Chair, Transplant Diagnostics Community of Practice, American Society of Transplantation

Pathology faculty, Drs. Nick Lukacs, Simon Hogan, Chang Kim, and Catherine Ptaschinski are members of the Mary H. Weiser Food Allergy Center (MHWFAC) with Dr. Nick Lukacs serving as the scientific director for this center. The center is in its 10th year since it was established in 2014 with robust research and outstanding researchers to contribute to the next phase of discovery and clinical therapies for food-allergic patients. The MHWFAC has had an outstanding year with the Center extending food allergy investigations into novel areas of translational discovery and patient-oriented research. Evidence of the Center's

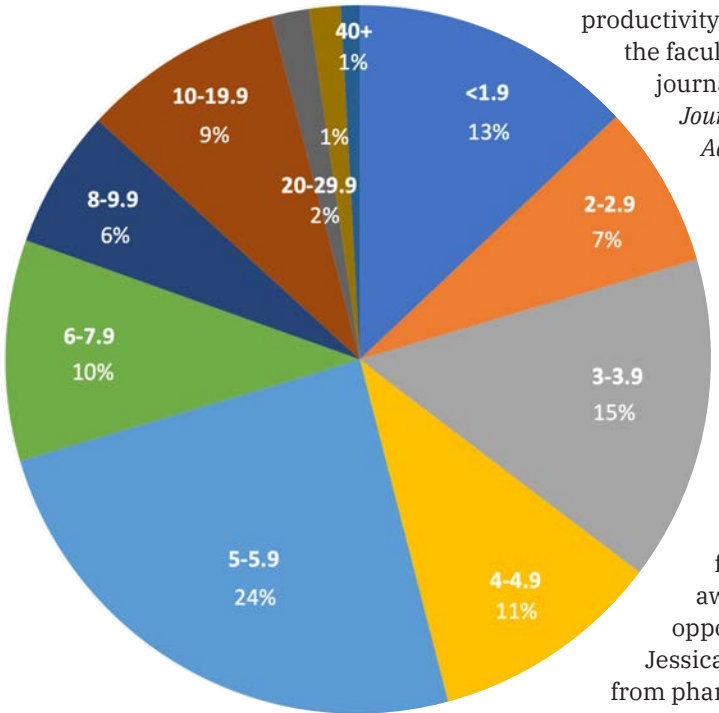


Chart: Manuscripts published in FY22-23 by journal impact factor.

productivity is illustrated by the high-impact studies that the faculty and their labs have published in top-tier journals, including *Journal of Clinical Investigation, Journal of Allergy and Clinical Immunology, Science Advances, Mucosal Immunology, Allergy*, etc. that number >25 total publications since fall of 2022. Another important goal of the MHWFAC is the acquisition of external funding through NIH, Foundation, and Industry grants to conduct cutting-edge research. Center faculty have had another very successful year with Dr. Catherine Ptaschinski, PhD receiving her first NIH R01 looking at a novel area in food allergy to define gut barrier. Dr. Chang Kim continued his funding with a new NIH R01 grant examining immune cell migration into gut tissue and Dr. Simon Hogan received new funding that was honored with an NIH MERIT award that extends the funding for 10 years as opposed to the normal 5 years. In addition, Drs. Jessica O'Konek and Simon Hogan received funding from pharmaceutical partners to perform cutting-edge research to help develop products that may eventually be used as treatments for food allergy patients. Along with our existing funding in numerous faculty labs, these newly funded projects indicate that the MHWFAC has built an outstanding research program through the outstanding faculty laboratories.

EP faculty research productivity is supported by many discoveries and high-impact publications. Pathology faculty published 391 manuscripts in high-impact journals that include, *Nature Communications, Nature Chemical Biology, Journal of Clinical Investigation, Cell Host and Microbes,* and *Proceedings of the National Academy of Sciences*, among many others. 24% of manuscripts were published in journals with an impact factor of greater than 10 and an additional 34% were accepted in journals that have an impact factor of 6-10.

Among the many outstanding published manuscripts, a few highlights this year include the following:

- The intracellular cholesterol transporter NPC1 functions in late endosomes and lysosomes to efflux unesterified cholesterol, and its deficiency causes Niemann-Pick disease Type C, an autosomal recessive lysosomal disorder characterized by progressive neurodegeneration and early death. In a recent study Dr. Andrew Lieberman's group used single-nucleus RNA-seq on Npc1-/- mice at P16 to identify cell types and pathways affected early in pathogenesis. These studies uncovered transcriptional changes in the oligodendrocyte lineage during developmental myelination, accompanied by diminished maturation of myelinating oligodendrocytes. Upregulation of genes associated with neurogenesis and synapse formation in Npc1-/- oligodendrocyte lineage cells were identified, reflecting diminished gene silencing by H3K27me3. Npc1-/- oligodendrocyte progenitor cells reproduce impaired maturation *in vitro*, and this phenotype was rescued by treatment with GSK-J4, a small molecule inhibitor of H3K27 demethylases. Moreover, mobilizing stored cholesterol in Npc1-/- mice by a single administration of 2-hydroxypropyl-β-cyclodextrin at P7 rescued myelination, epigenetic marks, and oligodendrocyte gene expression. Our findings highlight an important role for NPC1 in oligodendrocyte lineage maturation and epigenetic regulation and identify potential targets for therapeutic intervention.

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Article: Kunkel TJ, Townsend A, Sullivan KA, Merlet J, Schuchman EH, Jacobson DA, Lieberman AP. The cholesterol transporter NPC1 is essential for epigenetic regulation and maturation of oligodendrocyte lineage cells. *Nat Commun*. 2023 Jul 5;14(1):3964. doi: 10.1038/s41467-023-39733-6.

- A recent paper from Richard Miller's group demonstrated that an anti-aging diet, and four different anti-aging drugs that extend lifespan in mice, all produce parallel changes in plasma, fat, macrophages, brain, and muscle of young adult mice. These changes are likely to serve as Aging Rate Indicators and may be useful to screen quickly for drugs that could slow aging in mice, and, potentially, in humans.

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Article: Li, X., M. McPherson, M. Hager, M. Lee, R. A. Miller. 2023. Four anti-aging drugs and calorie-restricted diet produce parallel effects in fat, brain, muscle, macrophages

and plasma of young mice. *GeroScience*, https://doi.org/10.1007/s11357-023-00770-0.

- Drs. Charles A. Parkos and Asma Nusrat research groups identified expression and mechanisms by which an epithelial intercellular junction protein, claudin 23, controls barrier function in the intestine. In addition to using complementary *in vivo* and *in vitro* experimental techniques, they capitalized on cutting-edge computational modeling techniques to demonstrate how this protein functions to fortify the epithelial barrier by controlling architecture of pores between cells. These findings offer novel insights for therapeutic strategies aimed at reinforcing the epithelial barrier in situations where it is compromised or "leaky" in inflammatory disease states. Conversely, this knowledge will also help with the design of molecules that can selectively reduce barrier function to facilitate targeted drug delivery. In a second recently published study, the same group identified novel mechanisms by which another intercellular junction protein, CAR like membrane protein (CLMP) functions as a tumor suppressor by inhibiting the growth of intestinal adenocarcinoma cells.

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  Article: Raya-Sandino A, Lozada-Soto KM, Rajagopal N, Garcia-Hernandez V, Luissint AC, Brazil JC, Cui G, Koval M, Parkos CA, Nangia S, Nusrat A. Claudin-23 reshapes epithelial tight junction architecture to regulate barrier function. *Nat Commun*. 2023 Oct 5;14(1):6214.

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  Article: Luissint AC, Fan S, Nishio H, Lerario AM, Miranda J, Hilgarth RS, Cook J, Nusrat A, Parkos CA. CXADR-Like Membrane Protein Regulates Colonic Epithelial Cell Proliferation and Prevents Tumor Growth. *Gastroenterology*. 2023 Sep 14:S0016-5085(23)05002-3.

- Dr. Jiaqi Shi's group published a paper in which they identified the new role of a Lysine (K)-specific demethylase 6A (KDM6A) that frequently mutated tumor suppressor gene in pancreatic ductal adenocarcinoma (PDAC). Their study demonstrated that KDM6A loss in pancreatic cancer cells alters the immune microenvironment by increasing CXCL1 secretion and neutrophil recruitment, providing a rationale for targeting the CXCL1-CXCR2 signaling axis in tumors with low KDM6A.

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  Article: Yang J, Jin L, Kim HS, Tian F, Yi Z, Bedi K, Ljungman M, Pasca di Magliano M, Crawford H, Shi J: KDM6A Loss Recruits Tumor-Associated Neutrophils and Promotes Neutrophil Extracellular Trap Formation in Pancreatic Cancer. *Cancer Res*. 82(22): 4247-4260, 11/2022.

- A study by Dr. Andrew Muntean's group reported that >85% of patients with MLL-ENL translocations retain the YEATS epigenetic reading domain in resultant MLL-ENL fusion proteins. The authors demonstrated that the YEATS domain is necessary for MLL-ENL leukemogenesis by aiding in MLL-ENL fusion protein chromatin association, which maintains leukemic stem cell frequency. Additionally, the MLL-ENL leukemic cells are exquisitely sensitive to YEATS domain inhibitors that could represent a novel therapeutic strategy for these leukemias.

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  Article: The ENL YEATS epigenetic reader domain critically links MLL-ENL to leukemic stem cell frequency in t(11;19) Leukemia. Hu H, Saha N, Yang Y, Ahmad E, Lachowski L, Shrestha U, Premkumar V, Ropa J, Chen L, Teahan B, Grigsby S, Marschalek R, Nikolovska-Coleska Z, Muntean AG. *Leukemia.* 2023 Jan;37(1):190-201. doi: 10.1038/s41375-022-01765-0. Epub 2022 Nov 26.

- Dr. Analisa Difeo's group published a paper highlighting targeted therapies that have significant promise in cancer due to their oncogenic selectivity. However, due to the diversity and complexity of the many effectors and pathways involved, effective targets to treat ovarian cancer, high-grade serous carcinoma (HGSC), are lacking. The authors report first-in-class small compounds that stabilize the tumor suppressor Protein Phosphatase 2A (PP2A) as powerful inducers of cell death in numerous HGSC patient-derived models. The small molecule activator of PP2A (SMAP-061) induced degradation of a significant number of proteins involved in the DNA damage response and homologous recombination, resulting in a "BRCAness" phenotype. Furthermore, a combination of SMAP-061 with PARP

inhibitors (PARPi) resulted in synergistic cell death in a wide range of platinum susceptible and resistant mice. These findings shed insight on PP2A's previously unknown role in HGSC DNA damage response regulation, as well as a novel application of SMAPs in BRCA1/2 WT tumor populations to give a "BRCAness" phenotype, making these tumors more receptive to treatment with DNA repair inhibitors such as PARPi.

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Article: Avelar R*, Armstrong A, Carvette G, Gupta R, Puleo N, Colina J, Joseph P, Sobeck A, O'Connor C, Raines B, Gandhi A, Dziubinski M, Ma D, Resnick K, Singh S, Zanotti K, Nagel C, Waggoner S, Thomas D, Skala S, Zhang J, Narla G, DiFeo A: Small molecule mediated stabilization of PP2A modulates the Homologous Recombination pathway and potentiates DNA damage-induced cell death. *Mol Cancer Ther.* 2023: MCT-21-0880. doi: 10.1158/1535-7163.MCT-21-0880.

- Drs. Jolanta Grembecka and Tomek Cierpicki's labs are developing small molecule inhibitors of ASH1L histone methyltransferase as potential therapeutics for leukemia. In a recent published study, they characterized how a protein MRG15 facilitates activation of ASH1L methyltransferase activity. Employing the combination of biochemical methods and NMR spectroscopy, they discovered that MRG15 serves as an adapter protein necessary for binding of ASH1L to chromatin. Importantly, understanding ASH1L-MRG15 regulatory axis is crucial to more effective design of ASH1L inhibitors.

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  Article: Al-Harthi S, Li H, Winkler A, Szczepski K, Deng J, Grembecka J, Cierpicki T, Jaremko Ł. (2023) MRG15 activates histone methyltransferase activity of ASH1L by recruiting it to the nucleosomes. *Structure*; 31(10):1200-1207

Our 4th Annual Michigan Food Allergy Research Accelerator (M-FARA) Research Symposium was held in early June. The symposium this year was a 1-day event that focused on clinical research, spanning epidemiology and early life development of food allergy along with an important insight into birth cohort development with internationally renowned speakers presenting cutting-edge research. The speakers were chosen from Midwest food allergy centers, including Northwestern, the University of Wisconsin, Henry Ford Hospital in Detroit, Cincinnati Children's Hospital, the University of Indiana, and the University of Chicago. A primary goal was to bring together regional centers to forge novel ideas and new collaborations to help extend our clinical research enterprises to break new barriers in food allergy research.

Dr. Steven Kunkel continues to serve as the Chief Scientific Officer for Michigan Medicine. In his prominent leadership position, Dr. Kunkel has continued to play an important role in the development and implementation of robust strategic research plans that have facilitated novel directions for many research programs across Michigan Medicine.

Education Mission

Kathleen Cho, MD
Interim Director, Division of Education Programs

Sean Li, MD, PhD
Director, Residency Training Program

In FY23, The University of Michigan Pathology Residency Program continued its tradition of excellence, remaining the #1 program in the Midwest, #1 program among academic institutions, and #4 overall program nationally according to the Doximity Residency Navigator. The program was successfully reaccredited by the ACGME without citations or areas of concern and maintained a 5-year 97% first-attempt primary certification pass rate per the American Board of Pathology.

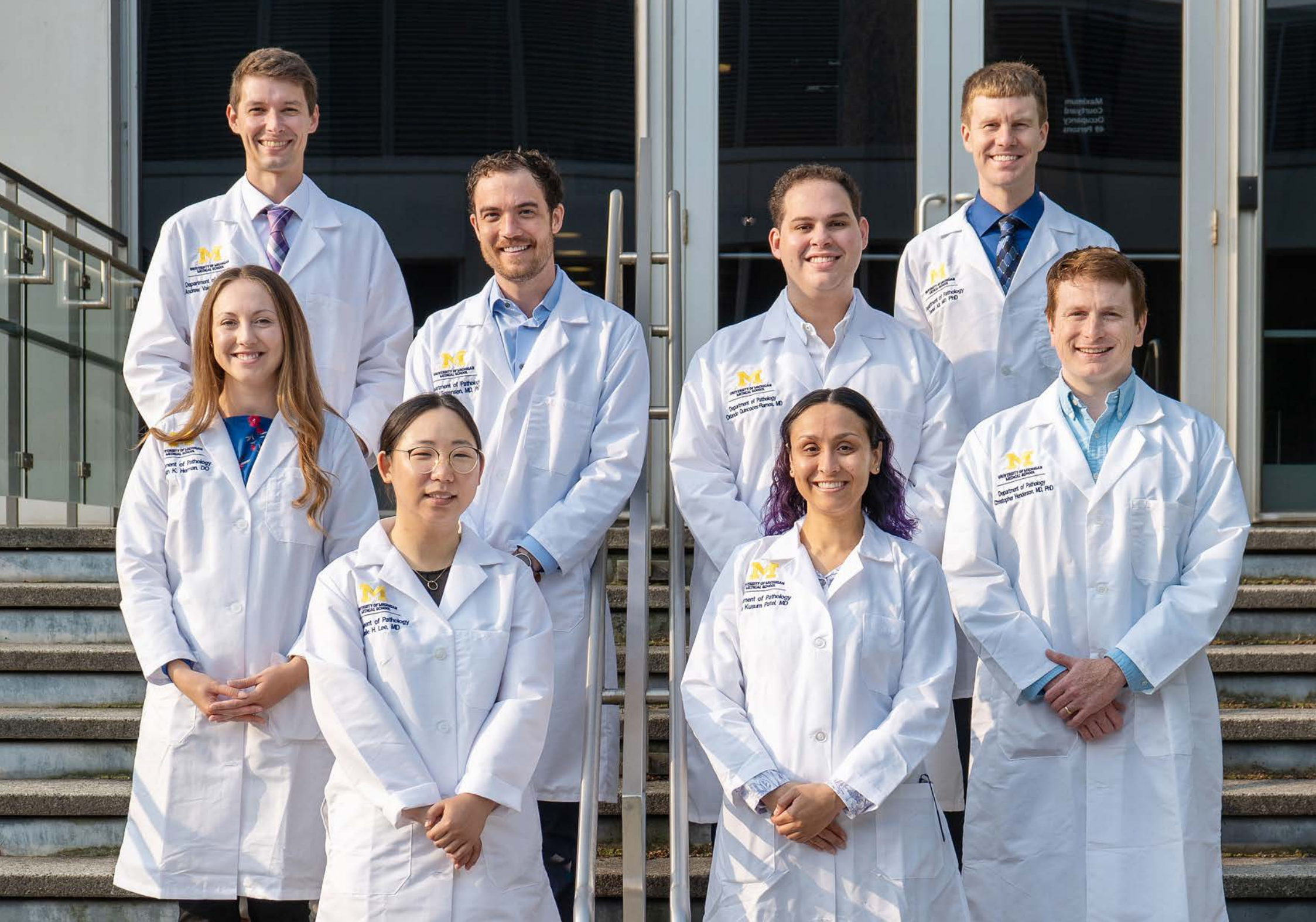
The Residency Program graduated seven AP/CP trainees and 1 CP-Physician-Scientist Training Pathway (PSTP) trainee. Six of these graduates are continuing their training in pathology subspecialty programs at Michigan Medicine, including breast pathology, dermatopathology, gastrointestinal pathology, gynecological pathology, molecular genetic pathology, and neuropathology. Two graduates embarked on pathology subspecialty training in hematopathology at the Medical College of Wisconsin and forensic pathology at The Office of the Chief Medical Examiner for Washington, DC. Notably, our inaugural AP/Neuropathology (NP)-PSTP trainee also completed their clinical education and successfully transitioned to the supported research portion of the Physician Scientist Training Pathway.

Some notable improvements were realized by the Residency Program in FY23. A 2-week Pathology Informatics rotation was piloted, led by Drs. Ulysses Balis and Jerome Cheng. After constructive feedback from residents, the PI rotation is now a required component of all pathology residency training pathways (AP/CP, AP-only, CP-only, and AP/NP) and is available to fellowship trainees on a first-come, first-served basis. A Wellness and Professional Development conference series was started in collaboration with the Trainee Wellness Committee and their advisor, Dr. Maria Westerhoff, drawing in speakers from around the country and was well attended by trainees and faculty. Dr. Laura Lamps piloted a 1-on-1 program to help residents improve their presentation skills, using the AP case conference series as a model. With positive feedback from residents, the program now continues into its second year under Dr. Rouba Ali-Fehmi. A new Wellness Policy drafted by Dr. Sara Abbott was approved by the Program Evaluation Committee, cataloging numerous resources within the department, university, and community to help support trainee wellness in and out of the workplace. A gross pathology volunteer coverage system was developed by the residents to address service gaps by either pathology assistant or resident staffing shortages. The spectrum of these improvements would not be possible without the passion and commitment of our trainees, faculty, and staff.

Our residents continued to represent our department well with their strong academic productivity and diligent service work in FY23. Twenty-five peer-reviewed articles were published in 22 journals, with 4 journals having an impact factor of 10 or greater. In addition, our residents published 9 articles in online medicine and pathology magazines and newsletters. Furthermore, 17 abstracts were presented at 13 national or regional meetings. Our residents served on 10 departmental, institutional, and national/international committees and were active members in 33 professional societies.

For the FY23 recruiting season, the Residency Program received 593 ERAS applications for 8 HO-1 positions and interviewed 97 candidates. The Program filled in The Match and welcomed the following excellent new trainees:

- **Daniel Alt, MD, PhD** / Case Western Reserve University
- **Christopher Henderson, MD, PhD** / University of Virginia
- **Meredith Herman, DO** / Michigan State University
- **Jenelle Lee, MD** / Western Michigan University
- **Nicole Patel, MD** / University of Michigan
- **Orlando Quincoces, MD** / University of Puerto Rico
- **Jacob Sorenson, MD, PhD** / University of Nevada



- **Andrew Valesano, MD, PhD** / University of Michigan

Pathology Fellowship Programs

In 2022, the Department of Pathology had 10 ACGME accredited fellowship programs with 18 approved positions plus an additional 9 clinical fellowship programs with 13 potential positions. On July 1, 2022, we welcomed the following clinical fellows:

- Blood Bank/Transfusion Medicine — Nada Naiyer, MD
- Bone and Soft Tissue — Chaehwa Kim, MD
- Chemical Pathology — Mallika Krishnan, DO
- Cytopathology — Heather Chen-Yost, MD & Ashley Bradt, DO
- Dermatopathology — Carli Whittington, MD & Jasmine Saleh, MD
- Forensic Pathology — Catherine Perez, MD & Sadiq Alqutub MD
- Gastrointestinal Pathology — Margaret Fang, MD
- Genitourinary Pathology — Fernando Cordeiro-Rudnisky, MD
- Gynecologic & Breast Pathology — Alex Taylor, MD
- Head and Neck Pathology — Cisely Hines, MD
- Hematopathology — Effrain Gutierrez-Lanz, MD & Justin Kelley, MD
- Laboratory Genetics & Genomics — Benjamin Kang, PhD (Year 2)
- Molecular Genetic Pathology — Suguna Narayan MD, PhD
- Neuropathology — Emile Pinarbasi, MD, PhD (Year 2)
- Surgical Pathology — Kathryn Gibbons MD, Xiaobing Jin MD, PhD, Sundis Mahmood DO, and Sabina Desar, MBBS
- Thoracic Pathology — William Perry, MD

Madelyn Lew, MD
Director, Medical School Pathology Education Curriculum

Medical Student Teaching

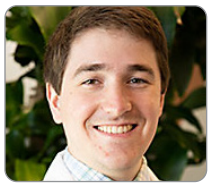
The Department of Pathology has a long history of playing an integral role in pre-clinical medical student education.

In Foundations of Medicine 2, one of the first sequences encountered by medical students in the Scientific Trunk, we introduce the foundational principles of Pathology – Cell Injury & Death, Inflammation, and Neoplasia. This lays the groundwork upon which students build in subsequent organ-based blocks. Lectures and laboratories are conducted by many pathology faculty members including Drs. Madelyn Lew, Scott Owens, Evan Farkash, Scott Bresler, Alexandra Hristov, Allecia Wilson, Tao Huang, Paul Killen, Aaron Udager, Karen Choi, Jiaqi Shi, Shula Schecter, Angela Wu, Tom Giordano, Richard Cantley, Sara Abbott, David Chapel, Caroline (Libby) Simon, May Chan, Steven Pipe, Laura Cooling, Kyle Conway, Sean Ferris, Stephanie Skala, and Paul Harms.

Under the direction of Dr. Madelyn Lew, Director of Medical Student Education for the Department of Pathology, our faculty members are working to continue integrating pathology content with other clinical and basic science elements in blocks and to incorporate new interactive methods of delivering educational material. In the Surgery & Applied Sciences Clerkship, students partake in a week-long pathology rotation that exposes them to various facets of pathology. The curriculum incorporates educational grossing and microscopic sessions directed specifically to medical students. Using these sessions along with case-based small group sessions focused on Clinical Pathology learning material and supplemental electronic resources, students will consolidate foundational principles learned in the Scientific Trunk, enhance their understanding of clinicopathologic correlations, and increase lab stewardship.

In their third and fourth years of the medical school curriculum, students enroll in the Branches curricula. In the Branches, pathology faculty participate as mentors and career advisors for the Diagnostics & Therapeutics Branch as well as Science Consultants for Branch students preparing their Patient Based Scientific Inquiry (PBSI). Branch students can also participate in a variety of integrated electives that include multiple disciplines to enhance their understanding of disease process, presentation, and management within the pathology department.

Batoul Aoun, DO
Chief Resident



Nathan McCammon, MD
Assistant Chief / HO III

Corey Post, MD
Assistant Chief / HO III

Geoffrey Halling, MD
HO IV

Ryan Landvater, MD
HO IV

David Nai, MD
HO IV

Emile Pinarbasi, MD, PhD
HO IV

Jaclyn Plotzke, MD
HO IV

Julianne Szczepanski, MD
HO IV

Katelyn Zebrowski, MD
HO IV

Haley Amoth, MD
HO III

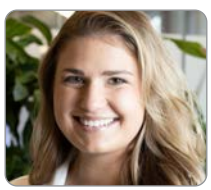
Thomas Herb, MD
HO III

Vincent Laufer, MD, PhD
HO III

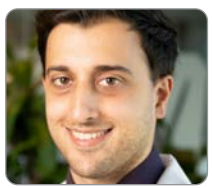
Fysal Shennib, MD
HO III

Nicole Tomm, MD
HO III

Maxwell Wang, MD
HO III

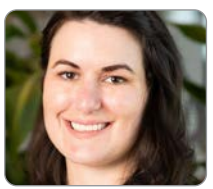


Ashley Brent, MD
HO II



Ryan Cecchi, MD
HO II

Elaina Daniels, MD
HO II



Elizabeth Higginson, MD
HO II

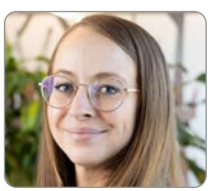
Amber Holtz, MD
HO II

Michael Olp, MD
HO II

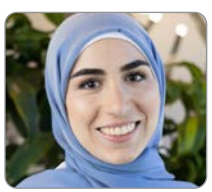
Eric Chang, MD
HO I

Jang Cho, MD
HO I

Timothy Dinh, MD, PhD
HO I

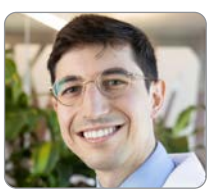


Isabella Holmes, DO
HO I



Sarah Farran, MD, MPH
HO I

Lauren Miller, MD, MJ
HO I



Mark Rudolf, MD, PhD
HO I

Daniel Alt, MD, PhD
Incoming HO I

Chris Henderson, MD, PhD
Incoming HO I

Meredith Herman, DO
Incoming HO I

Jenelle Lee, MD
Incoming HO I

Nicole Patel, MD
Incoming HO I

Orlando Quincoces, MD
Incoming HO I

Jacob Sorenson, MD
Incoming HO I

Andrew Valesano, MD, PhD
Incoming HO I

2022-2023

Pathology Residents

Pathology Elective Rotations

The General Pathology Elective experience, under the direction of Dr. Madelyn Lew, allows students to take a closer look at the daily practice of academic pathologists across multiple subspecialties. In 2022, we redesigned the elective with a "Pathology Passport" in which students self-develop an experience tailored to their interests and complete a combination of required and optional rotation-specific activities for designated point values (based on difficulty and effort) that accumulate to Pass, High Pass, or Honor grades. These activities include observation and participation in macroscopic evaluation of specimens, independent previewing of active clinical cases, and leading group discussion about case-related ancillary studies and clinicopathologic correlations. While many of the students rotating in our elective may choose other fields of practice, a distinct subset takes part in our elective to evaluate pathology as a possible career choice. For these students, individualized mentoring is provided by faculty in the department. Additional subspecialty electives in Dermatopathology and Neuropathology are also available learning opportunities for students.

Zaneta Nikolovska-Coleska, PhD
Director, Molecular and Cellular Pathology Graduate Program

Molecular and Cellular Pathology Graduate Program

The mission of the Molecular and Cellular Pathology (MCP) Graduate Program is to train the next generation of "Bench to Bedside" scientists with a focus on the study of the molecular and cellular mechanisms underlying the pathogenesis of human diseases. Inaugurated in 1992, the MCP program is hosted by the Department of Pathology and takes advantage of its unique position in a department that bridges basic and clinical sciences to encourage interdisciplinary projects and interdepartmental cooperation. The 25 students currently enrolled in the MCP program perform transformative research, ranging from basic to translational research in one of the >35 MCP research labs. The MCP Graduate Program bridges basic and clinical sciences and promotes interdisciplinary translational research to advance the application of scientific discoveries, providing an enhanced educational experience and training in "Bench to Bedside" approaches. Our goal is to recruit a diverse group of talented MCP students and to provide them with the best educational environment to train and to prepare for the next stage of their careers in academia, the biotech/pharma industry, teaching, scientific publishing, clinical research, or governmental/regulatory agencies.

Dr. Zaneta Nikolovska-Coleska was appointed as the new Associate Dean of Graduate and Postdoctoral Studies in the Office of Graduate Student Programs and stepped down from her MCP Director position. In March 2023, Drs. Simon Hogan and Jean-Francois (Jeff) Rual were named new MCP Program Co-Directors. The MCP community will celebrate the 10 years of service of Dr. Zaneta Nikolovska-Coleska as MCP Director (2013-2023) at the 22nd Annual Pathology Symposium in November 2023.

Students join the MCP program via either the Program in Biomedical Sciences (PIBS, for PhD students) or the Medical Scientist Training Program (MSTP, for MD/PhD students). Six first-year students joined the program via PIBS in 2022: Franchesca Fonseca-Lanza, Max Keller, Grace McIntyre, Sydney Musser, Charukesi Sivakumar and Madeline Sykes. As of the end of the 2022-2023 academic year there were 25 students enrolled in the MCP program including 24 PhD students and 1 MD/PhD student. *(See latest graduate thesis defense and current position, pg. 85)*

The preliminary examination ("prelim") aims to test the student's ability to identify a novel scientific hypothesis and to develop a rational research plan to test this hypothesis. Three students successfully completed their preliminary examination in December 2022, and passed to candidacy status allowing them to focus on their research thesis work: Rodolfo Ismael Cabrera Silva (Parkos/Nusrat Lab), Koral Campbell (Li Lab) and Joanna Lum (Venneti Lab).

Three MCP students graduated in FY23:

Graduate	Current Position
Siva Kumar Natarajan	Research Fellow (UM)
Hsiang-Yu Hu	AstraZeneca (Postdoctoral Fellow)
Rita Avelar	Research Fellow (UM)

To date (June 2023), 83 students have graduated from the MCP program.

Sadiq Alqutub, MD
Forensic Fellow

Ashley Bradt, DO
Pathologist

Heather Chen-Yost, MD
Thoracic Fellow

F. Cordeiro-Rudinsky, MD
Pathologists

Sabina Desar, MBBS
GU Fellow

Margaret Fang, MD
Pathologist

Kathryn Gibbons, MD
Pathologist

Efrain Gutierrez-Lanz, MD
Surgical Pathology Fellow

Cisely Hines, MD
Pathologist

Xiaobing Jin, MD, PhD
Assistant Professor

Benjamin Kang, PhD, MBA
Assistant Professor

Justin Kelley, MD
Assistant Professor

Chaehwa Kim, MD
Pathologist

Sundis Mahmood, DO
Junior Attending

S. Mallika Krishnan, DO
Director, Chemistry

Nada Naiyer, MD
Pathology Specialist

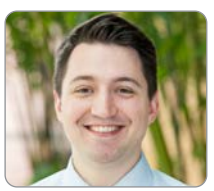
Suguna Narayan, MD, PhD
Informatics Fellow

Catherine Perez, MD
Medical Examiner's Office

Will Perry, MD
Head & Neck Fellow

Emile Pinarbasi, MD, PhD
Physician Scientist Training

Jasmine Saleh, MD
Dermatopathologist



Alex Taylor, MD
GU Pathology

Carli Whittington, MD
Assistant Professor

Graduating Fellows	Institution
Sadiq Alqutub, MD	Michigan Medicine
Ashley Bradt, DO	Grand Traverse Pathology, LCC
Heather Chen-Yost, MD	Michigan Medicine
Efrain Gutierrez-Lanz, MD	Michigan Medicine
Benjamin Kang, PhD, MBA	Vanderbilt University
Justin Kelley, MD	Vanderbilt University
Subhashree Mallika Krishnan, DO	Beaumont/Corewill Health
Nada Naiyer, MD	Corewell Health, Grand Rapids, MI
Suguna Narayan, MD, PhD	Michigan Medicine
Catherine Perez, MD	Wayne State University
Emile Pinarbasi, MD, PhD	Michigan Medicine
Jasmine Saleh, MD	Tareen Dermatology
Carli Whittington, MD	Indiana University

Graduating Clinical Instructors	Institution
Fernanda Cordeiro-Rudinsky, MD	University of Flordia
Sabina Desar, MBBS	Michigan Medicine
Margaret Fang, MD	VA Ann Arbor Health Care
Kathryn Gibbons, MD	St. Vincent's Hospital, Toledo, OH
Cisely Hines, MD	East Carolina University Health Center
Xiaobing Jin, MD, PhD	Michigan Medicine, Department of Pathology
Chaehwa Kim, MD	Sparrow Hospital
Sundis Mahmood, DO	St. Luke's University Network
Will Perry, MD	Michigan Medicine
Alex Taylor, MD	Boyce & Bynum, Columbia, MO

MCP Research Symposium

One of the marquee events in the Department of Pathology is our Annual MCP Research Symposium. The symposium, which is organized by third year MCP students, features oral and poster presentations by our faculty and trainees, highlighting the innovative research undertaken in the Department of Pathology, and a career panel to discuss career pathways for PhD and MD/PhD graduates. The symposium concludes with an awards ceremony presenting the MCP Outstanding Research and Service Awards, as well as awards for the best oral and poster presentations. The symposium provides numerous opportunities for exciting and stimulating interactions between our students and faculty through discussions and sharing ideas.

Peer-Reviewed Publications by MCP students

First or co-first authorship papers:

- **Alexander Monovich** – *Blood Cancer Discovery* (IF: 11.4) – PMID: 36350827 (Note: MCP students Chu, Shih-Chun and Iyer, Ashwin are co-authors on this manuscript)
- **Hsiangyu Hu** – *Leukemia* (IF: 11.4) – PMID: 36435883
- **Rita Avelar** – *Molecular Cancer Therapeutics* (IF: 5.7) – PMID: 36788429 (Note: MCP student Puleo, Noah is co-author on this manuscript)

Other co-author papers:

- **Sahiti Marella** – *Clinical and Experimental Allergy* (IF: 6.1) – PMID: 35778876
- **Alexander Monovich** – *Autophagy* PMID: 34704522
- **Siva Kumar Natarajan** – *PNAS* (IF: 12.8) – PMID: 37094128
- **Michael Pitter** – *Cells* (IF: 6) – PMID: 36899836
- **Jessica Teitel** – *Development* (IF: 4.6) – PMID: 36645371

Financial Support and Awards

Students in good standing are fully supported for their tuition, health care benefits, and stipend throughout their graduate studies (current stipend: $38,970). MCP students also have access to numerous grant opportunities, fellowship awards and financial aid from MCP or the Department of Pathology, from the U-M Rackham Graduate School or the U-M Office of Graduate & Postdoctoral Studies (OGPS), as well as from extramural institutions. The MCP supports graduate students by awarding the MCP Student Research Grant, a competitive award (internal competition) designed to support a student-initiated research project and to advance their progress toward their degree. This $3,000 grant is intended to support an exploratory research question relevant to the student's thesis and to encourage the independent research work of the students by providing support for novel/risky ideas that might provide proof of concept for feasibility and further study. For example, in 2023, MD/PhD MSTP student Kristen Lozada Soto (Nusrat-Parkos Lab) received a Research Grant to investigate how the CLDN23 proteins orchestrates intestinal mucosal wound repair by identifying possible molecular targets using spatial transcriptomic technologies.

Extramural awards. MCP students continue to be successful in obtaining prestigious extramural research awards and fellowships during their graduate studies. Ten MCP students were supported by external fellowships or awards during the 2022-2023 academic year:

- **Sahiti Marella** (*Hogan Lab*): NIH F31 Fellowship (2023 - 2024)
- **Jessica Teitel** (*DiFeo Lab*): NIH F31 Fellowship (2022 - 2024)
- **Kristen Lozada Soto** (*Parkos-Nusrat Lab*): NIH F30 Fellowship (2022 - 2024)
- **Derek Dang** (*Venneti Lab*): NIH F31 Fellowship (2021 - 2023)
- **Michael Pitter** (*Zou Lab*): NIH Research Supplements to Promote Diversity in Health-Related Research (2021 - 2023)
- **Gabrielle M. Rozumek** (*Prasov Lab*): Research Supplements to Promote Diversity in Health-Related Research (NIH) (2022 - 2023)

- **Noah Puleo** (*DiFeo Lab*): TPTR, NIH T32 Predoctoral Fellowship (2022 - 2024)
- **Joanna Lum** (*Venneti Lab*): TPTR, NIH T32 Predoctoral Fellowship (2022 - 2024)
- **Alexander Monovich** (*Ryan Lab*): Proteogenomics of Cancer, NIH T32 Predoctoral Fellowship (2021 - 2023)
- **Grace McIntyre** (*DiFeo Lab*): National Science Foundation (NSF) Graduate Research Fellowship (2022 - 2025)
- **Michael Pitter** (*Zou Lab*): American Association of Immunologists Trainee Abstract Award (2023)

Internal U-M awards and fellowships (e.g., from Rackham or OGPS, not including MCP-sponsored awards) supporting MCP students in 2023 include:

- **Joanna Lum** (*Venneti Lab*): Rackham Merit Fellowship (2021 - 2025)
- **Mohamed Mire** (*Lukacs Lab*): Rackham Merit Fellowship (2019 - 2023)
- **Koral Campbell** (*Li Lab*): Rackham Graduate Student Research Grant (2023)
- **Thaddeus Kunkel** (*Lieberman Lab*): Rackham Travel Grant (2023)
- **Hsiangyu Hu** (*Muntean Lab*): Rackham Travel Grant (2023)
- **Sanjana Eyunni** (*Chinnaiyan Lab*): Rackham Travel Grant (2023)
- **Siva Kumar Natarajan** (*Venneti Lab*): Rackham Travel Grant (2023)
- **Noah Puleo** (*DiFeo Lab*): Rackham Travel Grant (2023)
- **Jessica Teitel** (*DiFeo Lab*): Rackham Travel Grant (2023)
- **Agamjot Sangotra** (*Lieberman Lab*): Rackham Travel Grant (2023)
- **Derek Dang** (*Venneti Lab*): Rackham Travel Grant (2023)
- **Brian Basinski** (*Rao Lab*): Rackham Travel Grant (2023)

Community Service and Outreach

Many MCP students give back to the community through educational and community outreach programs. MCP students have a long track record of being impactful benefactors in their community. The selfless dedication of our students to community service is recognized with one student named the MCP Outstanding Service Award recipient annually at the Annual MCP Research Symposium. At the 21st Annual MCP Research Symposium, two students received the 2022 MCP Outstanding Service Award: Derek Dang (Venneti Lab) and Jessica Teitel (DiFeo Lab). Derek's mentor writes that he, "has been passionate about being a global citizen and advocating for underprivileged children" while "striving to contribute to equality, diversity, and inclusion." Jessica's community service work has centered around communication, mentorship, and high-school outreach in "an effort to increase the number of capable and qualified disadvantaged and minority students here at UM."

The MCP team was also proud to share the news last June that Derek Dang (Venneti Lab) had also been selected among all Rackham Graduate School students as the recipient of the 2023 Phyllis M. Wise Biomedical Sciences Graduate Student Award for Excellence in Service. Derek is an enthusiastic leader and organizer in multiple service organizations and has served as an advocate, coach, and educator for young people and STEM trainees in many ways, e.g. with Fathers and Sons Together (FAST), a youth and family development program with which he has been involved for the last seven years that focuses on improving educational and health outcomes among Black youth in his hometown of Seattle.

Several MCP students serve as instructors at the Developing Future Biologists (DFB), an educational outreach organization that trains the next generation of biologists, regardless of race, gender, or socioeconomic status. In May 2023, the Department of Pathology and MCP combined agreed to contribute to the DFB program $2,000 per year for 5 years (Total $10,000). MCP is grateful for the Department's support of our MCP students' outreach activities.

Furthermore, MCP students are actively involved in various students organizations focusing on DEI (F.E.M.M.E.S and

SACNAS), K-12 education (SEEK), professional development (ESPA and BGSG), science communication (MISciWriters), business consulting (miLEAD), and more (featured here by PIBS). These organizations are a great way for students to become actively involved in campus issues or community outreach, to connect with other students who may have similar interests, and to build leadership and mentoring skills.

Social Events The MCP community meets regularly to socialize. Social events in 2022 include: an annual picnic at Island Drive Park (August 2022), ice-cream social to welcome first year MCP students into our community (August 2022), happy hour at Casa Dominick's (May 2022), and an upscale dinner at Vinology to kick off the 21st Annual MCP Research Symposium (November 2022).

Allied Health Education

In FY23, the Allied Health Education program hired a new manager, Karen Barron, who led efforts to expand on offerings to support Pathology employees, educate interns, and raise awareness of medical laboratory professions in the community. Barron coordinated the return of in-person New Employee Orientation, with tours of the NCRC and UH. In addition, an Allied Health Continuing Education webpage was created to give employees resources and links for professional development and free continuing education, https://www.pathology.med.umich.edu/allied-health.

The Department expanded its internship offerings to include internships for technologists in microbiology, histotechnicians, and an externship for phlebotomists. These complemented the existing Medical Laboratory Scientist internship program, which graduated 14 students in FY23. The two new internship programs each graduated their first students and the phlebotomy externship had five students complete their training in FY23.

Visits to high schools in Washtenaw and Wayne counties reached hundreds of youths with information about medical laboratory professions and job opportunities at Michigan Medicine Pathology. Ann Arbor High School Health Occupations students job shadowed in our Core Lab, giving these students a first-hand look at pathology careers. Participation at special events like the Youth Summit at the Big House and Parkridge Community Festival reached students and adults who are underrepresented in medical laboratory careers, complementing the efforts being made by our DEI office to recruit a diverse labor force in the department.

Conferences and Symposia

21st Annual Pathology Research Symposium

November 4, 2022

This symposium featured lectures from Molecular and Cellular Pathology doctoral candidates, Michigan Medicine faculty, and visiting professors to offer attendees a broad view of molecular and cellular pathology research. The keynote lecture, "Protein and peptide therapeutics based on blueprints from nature", was presented by James Olson, MD, PhD, Professor of Clinical Research Division at the Fred Hutch University of Washington School of Medicine. Dr. Olson presented a fascinating review of his work focusing on developing and advancing mini-proteins found in scorpion venom toxin and other natural sources as potential therapeutics, especially in the treatment of brain cancers in children.

The Clinical Pathology Symposium

April 25, 2023

"Resilience. Rebound. Readiness", the CP Symposium energized about 140 attendees with 3 featured speakers and 13 exhibits by Pathology groups. Dr. Kelcey Stratton, Program Manager of the Resilience and Well-Being Services and Clinical Assistant Professor in the Department of Psychiatry at Michigan Medicine, spoke on "(Re)Connection: Building Community and Resilience", encouraging participants to purposely find joy in their everyday lives, and to recognize how empathy and positive connections contribute to resilience. This was followed by the Batsakis Lecture by Dr. Aubree Gordon, Associate Professor of Epidemiology and Director of the Michigan Center for Infectious Disease Threats. Her lecture, "Immunity associated with SARS CoV-2 (IASO) Cohort Study," focused on the study design and early results from the COVID pandemic-related study, including immune response to SARS-CoV-2 infection vs. vaccination. Participants learned how antibody development via vaccination

differed from those developed via infection and how these differences enabled researchers to determine the duration and effectiveness of immune responses to the virus as it continued to mutate in the population. The final session of the day, "Next Generation Sequencing Primer and Future Direction of Molecular Diagnostics" was presented by Dr. Nora Joseph, Assistant Professor of Gastrointestinal and Hepatobiliary Pathology, Michigan Medicine Department of Pathology. Joseph reviewed the criteria for various types of samples to be used on multiple PCR and NGS platforms, the evolution of molecular diagnostic testing for infectious diseases and neoplasia, and the advantages and disadvantages of multiplex nucleic acid testing.

6th Annual T32 TPTR Retreat
May 24, 2023

At this event the trainees presented their translational research projects. The keynote speaker was Kojo Elenitoba-Johnson, MD, James Ewing Alumni Chair of Pathology, Memorial Sloan Kettering Cancer Center, and Professor, Graduate School of Biomedical Sciences, Gerstner Sloan Kettering Graduate School.

The research seminar series is held weekly and highlights research from our own faculty and trainees as well as research conducted by invited guest lecturers. This year we invited the following speakers: Senad Divanovic, PhD (Cincinnati Children's Hospital), Dennis Jones, PhD (Boston University), Arianne Theiss, PhD, AGAF (University of Colorado Denver) and Omer Yilmaz, PhD (Massachusetts Institute of Technology).

The T32 TPTR holds monthly workshops covering topics of relevance to translational research and showcases the work being done by our trainees. This year we had presentations from Purna Garimella, Drs. Nick Lukacs and Scott Denstaedt from the University of Michigan. We also had presentations by trainees Lwar Naing (Cascalho lab), Padma Kadiyala (Pasca di Magliano lab), Noah Puleo (DiFeo lab) and Joanna Lum (Venneti lab).

Chris Rigney (left) and Kristina Martin (right) presenting speakers during the 2023 Clinical Pathology Symposium.

Pathology Informatics

Ulysses Balis, MD
Director, Pathology Informatics

The Division of Pathology Informatics (PI), which serves as one of the functional units of the overall Pathology Department, serves the tripartite missions of the department, including clinical operations support, original research, and education. As an informatics division, it is somewhat unique among contemporary academic pathology departments, in that it maintains both its own embedded teams of technical staff IT specialists and associated IT infrastructure, while still maintaining active dialog and alignment with the Health Enterprise's central IT group. This unique governance model allows the division to maintain its critically needed self-autonomy with respect to project oversight and prioritization, while at the same time leveraging consistent best-practice IT standards and methodologies, as determined by the health system at large. It affords the division both the ability to carry out internal prioritization of the department's many projects, as well as the ability to independently carry out original IT development efforts.

In addition, the division hosts its own active thrusts in fundamental areas of information technology, machine vision, and deep learning research, including computational imaging of Whole Slide Imaging (WSI) subject matter, asset tracking solutions, computational pathology, natural language processing, and medical information interoperability. Fundamentally, PI operates as a service unit within the greater department, covering a wide range of operational, strategic, and educational functions, with these various missions tied together by a centrally governed team of superbly trained information technology specialists who, at the same time, possess substantial familiarity with the clinical lab and its associated workflows.

The division is comprised of two full-time faculty, three adjunct faculty (with primary appointments in Anatomic Pathology, Molecular Pathology, and Clinical Pathology), two informatics fellows, and 43 full- or part-time staff. During this past year, Dr. Mustafa Yousif continued in his leadership role as director of Digital Pathology Implementation, successfully completing the complex process for selecting and purchasing an image management solution for the overall project (Sectra). In addition, his efforts, combined with that of the division and departmental leadership, allowed for Michigan Medicine's Health Enterprise leadership to recognize Digital Pathology as now being one of its institutional driver initiatives. Dr. Yousif continues to work closely with anatomical pathology leadership (e.g., Drs. Skala and Kunju), as well as with the Informatics Division at large, towards the goal of realizing the commencement of primary digital diagnosis by July of 2024, with select AP services already identified for initial roll-out.

Similarly, Dr. Lee Schroeder continues in his role as an adjunct faculty member of the Informatics Division, assisting with numerous instrumentation implementation efforts and IT policy issues that have overlapping jurisdiction between the clinical labs and IT governance.

Most recently, Dr. Robert Bell, whose primary appointment is within the Division of Diagnostic Genomics and Genetics, has also joined the Informatics Division as adjunct faculty. Given his formal fellowship training in Pathology Informatics at Washington University – St. Louis, in tandem with his molecular pathology fellowship training, his added skills complement those already present within the division. His addition represents the Division's fourth Clinical Informatics-boarded pathologist, thus making our team at Michigan one of the largest pathologist-led informatics groups in the nation.

In consonance with the growing number of the division's full-time and adjunct informatics faculty, the added number of the division's highly trained IT specialists brings the total division staffing to one of the largest stand-alone pathology informatics academic units in the US. The broad expertise represented by this team allows for the continued assignment of effort towards

both intramural and extramural academic endeavors, with a good example being the U01 grant that was awarded to the division with one of its members (Balis) serving as Co-PI.

The 2022–2023 fiscal year witnessed the continued evolution and growth of the Division's expansive portfolio of web-accessible dashboards and analytics tools. Many of the newer data products and associated displays are based on the use of a comprehensive, underlying data analytics / machine learning architecture. Examples of performance metrics now available include real-time case volume analysis in AP, turn-around time statistics by service, aggregate institution-wide blood products inventory, and blood draw volume, just to name a few.

The Division of Pathology Informatics (PI) at the University of Michigan Department of Pathology distinguishes itself from traditional pathology departments through its distinctive resources and configurations. By integrating the specialized expertise of laboratory medicine/anatomic pathology experts with Information Technology (IT), the department has formed a unique, symbiotic relationship that drives innovation and discovery.

Key to this is the division's distinctive governing model: maintaining its own embedded teams of technical staff IT specialists along with the associated IT infrastructure while also aligning with the Health Enterprise's central IT group. This model maintains the division's essential autonomy in overseeing and prioritizing projects but takes advantage of best practices in IT standards and methodologies throughout the health system. This duality provides benefits for both project prioritization and independent IT development.

The division's research foci are another distinguishing factor. The division has initiatives in fundamental areas of information technology, machine vision, and deep learning research. The employment of Whole Slide Imaging (WSI) subject matter, asset tracking solutions, computational pathology, natural language processing, and medical information interoperability sets this department apart, with unique abilities to explore and innovate.

While most pathology informatics units are limited in their clinical familiarity, the PI division has assembled a team of information technology experts well-acquainted with the internal workings of the clinical lab and its workflows. This blend of subject matter proficiency and technological expertise empowers the division to drive substantial innovation, from research initiatives to clinical operations.

The division's extensive and diverse staff, including faculty with primary appointments in various sub-disciplines of pathology and a high number of IT specialists, further differentiates it. This diverse expertise allows the division to assign effort towards both intramural and extramural academic endeavors, fostering a robust range of perspectives and collaboration that enriches its research capacity and accelerates innovation.

Leadership in the division, such as Dr. Mustafa Yousif's role in digital pathology implementation and Dr. Lee Schroeder's involvement in instrumentation implementation efforts, underscores the division's commitment to intertwining laboratory knowledge with IT expertise. The successful selection and purchasing of an image management solution under Dr. Yousif's supervision and the recognition of Digital Pathology as an institutional driver initiative are proof of the division's ability to apply IT expertise to enhance the implementation of lab practices.

Finally, the division's comprehensive data analytics/machine learning architecture and associated tools enhances its ability to innovate. Real-time analysis of factors like AP case volume, turn-around time statistics by service, and blood draw volume are now possible, thanks to the division's commitment to data-driven approaches.

In conclusion, the Division of Pathology Informatics at the University of Michigan stands out from traditional pathology departments due to its unique combination of resources, configurations, and expertise. By interweaving laboratory medicine/anatomic pathology expertise with IT knowledge, the department achieves accelerated innovation and discovery.

Division of Quality & Health Improvement

Scott Owens, MD
Director, Division of Quality and Health Improvement

During FY23, the Division of Quality and Health Improvement (DQHI) continued to make significant contributions in both the support of clinical operations and innovative practice developments with partners inside and outside of the Department of Pathology. DQHI's guiding principles continue to include an emphasis on practice efficiency and high-reliability principles, the expectation that changes and results will be solidly focused on adding value and as generalizable as possible throughout the Department and institution, a commitment to scoping projects for achievable results, and a focus on obtaining a mixture of subjective and objective measurements that allow for both assessment of impact and sharing of results in an academic format. Highlights of these efforts are provided below.

Operational Support and Process Improvement

DQHI personnel continue to focus on several critical support and improvement projects throughout the department. DQHI is in an ideal position to both cross boundaries between clinical labs and other clinical divisions – allowing for the creation and support of cross-functional teams sustained by our project managers, process improvement specialist, and data scientist – and to provide the appropriate staff bandwidth and expertise to shoulder this type of effort, allowing laboratory leadership and personnel to concentrate on their clinical work. In addition, our connections with like-minded people and groups in other departments throughout the institution provide crucial networks for broad and far-reaching impacts on patient care.

Over the past year, we completed a department-wide equipment inventory in collaboration with departmental administration and supply management, helping to support efficient operations. In addition, we completed a project in support of leadership in the Clinical Microbiology laboratory focused on the development and implementation of a visual and digital supply management system that allows for more efficient supply location, stock monitoring, and reordering. The same type of system is currently in development/deployment for other laboratories, as of now focusing on the Clinical Coagulation laboratory in Hematopathology.

In partnership with leadership in Anatomic Pathology (AP) and clinical personnel in the University Hospital operating room suite, DQHI successfully implemented a process improvement that eliminates hand-written labels on specimen containers that are generated during surgical procedures. This will help to minimize miscommunications for frozen sections and other specimens coming from the operating room. In addition, further improvements to the frozen section specimen process to provide better visual identification of specimens intended for intraoperative evaluation and better communication of frozen section results remain under consideration for future action.

DQHI personnel are also working in support of other clinical process improvement projects throughout the department. These include the development of new organizational and workflow paradigms in the field of molecular diagnostics in collaboration with leadership in the Division of Molecular Pathology, and partnerships with colleagues in Michigan Medicine Laboratories/MLabs (MML) centered on improving the approaches to accessioning and returns of outside consultation and transfer materials (glass slides and tissue blocks with associated paperwork). The most far-reaching set of projects undertaken in support of clinical operations over the past year centers on the infrastructure and management of the department's inpatient phlebotomy services, a critical part of patient care, a key patient-facing aspect of the department's activities, and a part of the department's work that garners the attention of clinical leadership throughout the institution.

In response to increased attention from those clinical leaders, DQHI personnel have partnered with departmental leaders to

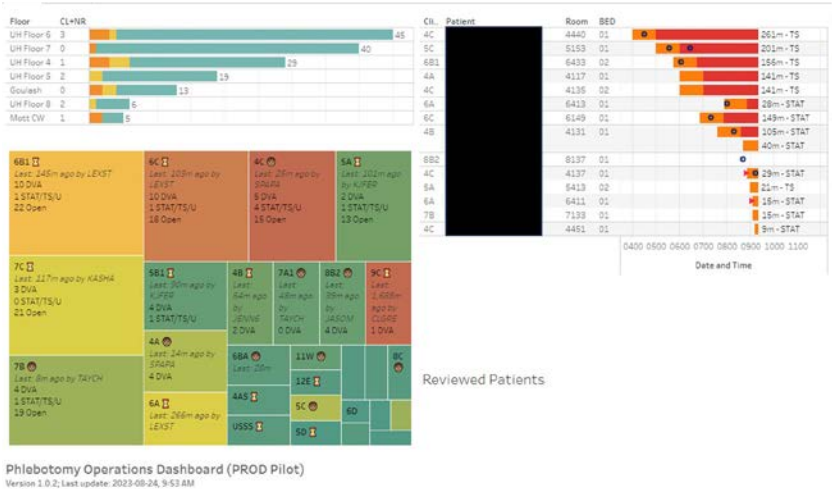


Figure 1: *"Flight Board"*

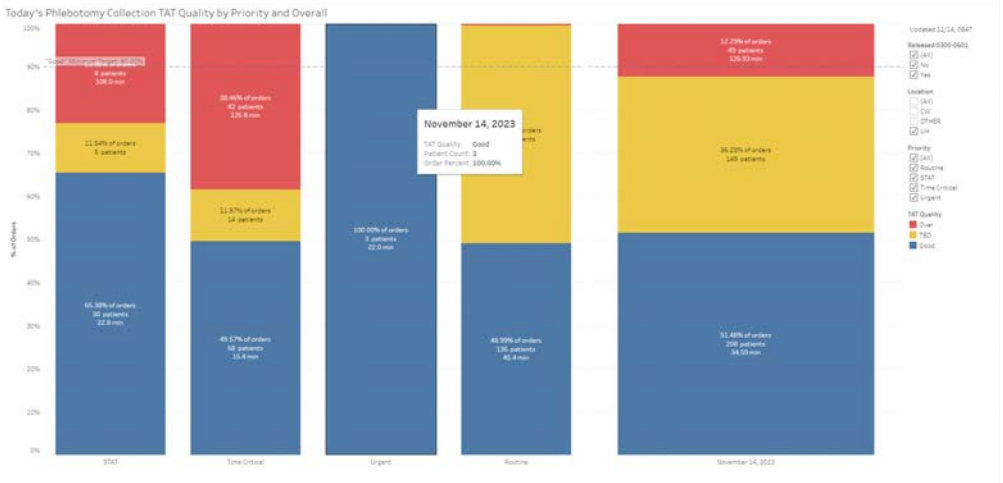


Figure 2: *Collection of TAT Quality by Priority and Overall.*

explore ways in which data-driven process improvement can transform the experience of patients and providers from the phlebotomy platform. In the spirit of high-reliability thinking, DQHI has chosen to take a holistic approach by understanding the entirety of the phlebotomy "ecosystem" and how it resides in and interacts with operations throughout the department, and by using objective data sources to understand opportunities for improvement and provide critical operational data to those managing the work of phlebotomy services. This has resulted in DQHI's data scientist and process-improvement specialist constructing a data warehouse that feeds a suite of visual management tools, providing real-time information in an "air traffic control-like" fashion that will allow managers of the inpatient phlebotomy team to understand the current demand for blood draws, how the phlebotomy team is responding to those demands, and how best to deploy and redeploy resources to positively impact patient care. The "Flight Board'' (Figure 1) that provides this information has been successfully piloted with good results and positive feedback from users, and work is underway to standardize its use and provide documentation that will allow multiple users to act as "air traffic controllers'' in support of the inpatient phlebotomy team. A supporting dashboard provides key stakeholders daily and historical information about overall phlebotomy performance, as well (Figure 2 and Figure 3 on pg. 67). Other projects stemming from DQHI's work in support of phlebotomy services include: the exploration of a demand-based scheduling system that would optimize phlebotomist scheduling based on historical ordering patterns; an electronic staffing solution that would allow for better deployment of phlebotomists and integration of this data into the Flight Board; and an initial study to understand what impact, if any, delayed inpatient blood draws have on timely patient discharge. An ancillary opportunity was also identified as part of DQHI's assessment of the phlebotomy services system. Currently, phlebotomists also pick up other inpatient specimens destined for a variety of laboratories within pathology as they make their rounds on the inpatient floors. DQHI is working on the identification of opportunities to streamline this process as part of the effort to utilize the department's phlebotomy resources most efficiently. Work on these projects is ongoing.

Finally, work on improvement of the utilization of the information gleaned from patient safety incident reports entered by and

about the clinical laboratories in the institutional patient safety reporting system is continuing. Historically, the information contained in this system has been a mixture of useful material that could potentially be utilized for process analysis and improvement, and less fruitful data that provides relatively little beyond documentation of specific events, making the "signal-to-noise" ratio quite low. To better utilize the beneficial portion of this data, DQHI personnel have instituted a project aimed at using data analytics to parse out actionable reports that may be best leveraged to become process improvement and/or operational support projects.

Laboratory Utilization

A key, ongoing project for FY23 continues a collaboration with colleagues in the Cardiology division of Internal Medicine, aimed at helping leadership in that group understand how their practitioners are using laboratory testing in the context of analytic and treatment protocols for patients with clinically significant heart failure. This collaborative quality initiative-like project has allowed DQHI personnel to provide project management, data science, data visualization, and clinical expertise, resulting in the development of a provider dashboard that is in early use to monitor provider behavior and ordering patterns in comparison to published and local care guidelines. The aim for this part of the project is to provide Cardiology leadership with the tools needed to provide direct feedback to practitioners and encourage standard practice. This platform is generalizable across clinical practices and could easily serve a similar purpose throughout the institution. The second phase of the project has centered on the use of laboratory testing and data science to provide practitioners with ongoing information about the optimal titration of medications to treat heart failure. Providing a "medication optimization score" (MOS) to clinical caregivers, this will give up-to-date therapeutic and patient health data that will allow more focused medication adjustments and, it is anticipated, better patient outcomes. Demonstrating this type of direct connection between optimal laboratory studies and patient outcomes has been a goal of DQHI since its inception, and the product is currently ready for full deployment. We are working with our partners in Cardiology, along with support from the Michigan Institute for Clinical and Health Research (MICHR), to structure a prospective, stepped-wedge approach trial of the tool aimed at objectively assessing its impact on patient outcomes, including the time to achievement of optimized treatment goals (based on MOS), number and length of hospitalizations, and optimization of laboratory utilization (reduced inappropriate testing) for heart failure patients.

Other DQHI interests in the arena of laboratory utilization include the use of broader data resources for the identification of opportunities for new decision support projects aimed at optimizing the use of laboratory services. One such resource, the Vizient database, provides a way to compare utilization at Michigan Medicine to peer institutions regionally and nationally, and early work has enabled DQHI personnel to explore how and when to leverage this information to identify potential future projects. The recent implementation of the HC-1 suite of data tools by MML should provide another potential source of data to follow laboratory utilization at Michigan Medicine and its partner institutions within the University of Michigan Health System to identify and exploit such opportunities. Finally, much laboratory utilization work at our institution and elsewhere has focused on the clinical laboratories, but there remain opportunities within the realm of anatomic pathology to effect more efficient use of resources, including the appropriate use of resource-intensive procedures such as immunohistochemistry and intraoperative consultations (frozen sections), and the optimization of tissue submission for microscopic examination to ensure that personnel and machinery in the histology laboratory are utilized at a high level and not overwhelmed. Early discussions about these AP-related opportunities have been undertaken and DQHI is committed to exploring them further.

DQHI continues to work on projects involving operational quality improvement and value creation, aiming to transform the experience of patients at Michigan Medicine and beyond by using the expertise inherent in laboratory medicine to impact patients' lives from a laboratory medicine and pathology platform. Efforts in operational support, process improvement, and laboratory stewardship, highlighted above, provide evidence of continued commitment to and impact in these areas.

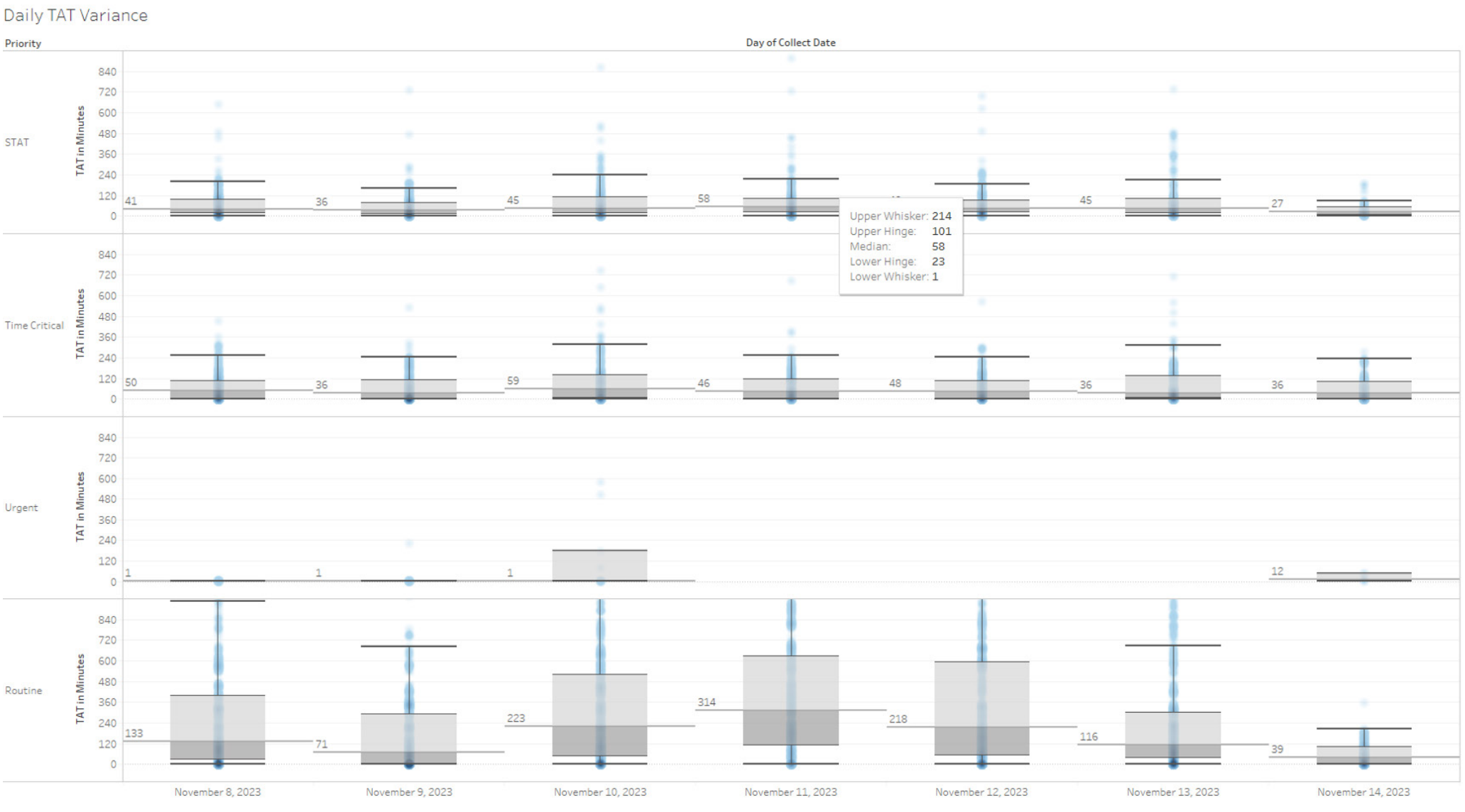


Figure 3: *Data of Daily TAT Variance.*

Wellness

Maria Westerhoff, MD
Assistant Chair, Wellness

Wellness is a priority in the Department of Pathology as evidenced by the naming of Dr. Maria Westerhoff as Assistant Chair for Wellness. In her first full year serving in this role, Dr. Westerhoff formed a Wellness Committee for faculty and staff comprised of Yvonne Beadle, Regina Ferguson, Dr. Nora Joseph, Tracey Rocco, and Anastazia Hartman; successfully won a grant from the institution to serve the department, and supported the Trainees' Wellness Committee efforts.

In FY23, several initiatives were undertaken to encourage wellness across the department.

- A faculty caretaker luncheon was launched and Dr. Helen Morgan, Professor of Obstetrics and Gynecology and Learning Health Systems, shared her experience balancing caretaking responsibilities with her professional life. A number of resources were assembled and made available in a shared drive.
- The department contracted with two local farms and provided a fresh vegetable distribution each week at the NCRC and at the University Hospital. These vegetables were eagerly received by members of the Pathology community as recipes and photos were shared by recipients.
- A $5,000 Wellness Influencer grant resulted in the recognition of approximately 100 staff members, whose contributions were named by nominating staff and were awarded for their wellness efforts in the department.
- Dr. Charles Parkos, Chair of Pathology, secured two sets of season tickets for football and men's basketball games. Members of Pathology entered their names in the drawings, then enthusiastically awaited the ticket winners to be drawn. Winners of these tickets were across the Pathology department from front line clinical staff at University Hospital, Canton, Northville to Researchers from various labs.
- Leadership led walks weekly on Fridays at noon. Participants included various departmental administrative and faculty leaders leading the walks and multiple staff and faculty from within the department.
- FiSH! Philosophy training was made available to the Department in February 2023 to bring about culture change. This was followed by a Train the Trainers session where six members of the staff trained to become certified FiSH! Philosophy trainers: Melina Adler, Gloria Barkley, Karen Barron, Chris Distelrath, Lynn McCain, and Julene Pummill. A FiSH! for Leaders session followed in the summer of FY23. The training team applied for a Michigan Medicine Wellness Grant and received an award for $5,000 to provide FiSH! training to members of Pathology. These classes are scheduled to commence in early FY24.
- Weekly Yoga sessions, arranged through MHealthy and led by Christine Baker, were offered to faculty and staff of the department to relax, stretch, and improve focus.

In FY24, the Wellness Committee has planned an art competition and special pastry distribution days to highlight our Wellness Influencers. Dr. Ul Balis developed software to automate specimen designation in SOFT diagnostic reports, to reduce typing required by faculty and trainees, to be offered soon.

Diversity, Equity, and Inclusion

Angela Wu, MD
Assistant Chair, Diversity, Equity, and Inclusion (DEI)

The Department of Pathology established the office of the Assistant Chair for Diversity, Equity, and Inclusion to provide ongoing efforts to improve DEI for all employees in the department. The goal of our DEI initiatives is to raise awareness and overcome biases as well as to incorporate DEI-centric initiatives in our recruitment and retention efforts.

In FY23, the DEI office had two major goals; the first was to engage our faculty and staff. We held our fourth annual Equality Walk on June 19th. Seventy-eight department members (including departmental leadership) participated, taking time from their busy day to reflect on social justice and to remember those who have lost their lives due to racial injustice. Last September, we hosted Dr. Renee Branch-Canady, CEO of Michigan Public Health Institute and Professor at MSU, who spoke to our department on how we can better promote social justice. We held several lunch and learns throughout the year, utilizing multi-media presentations to promote discussions of our personal journeys with race and culture in our department. Several private Journey to Freedom Underground Railroad bus tours, sponsored by the African American Cultural and Historical Museum of Washtenaw County, were organized by our DEI committee, and were well attended by both faculty and staff. A new DEI video for our department on our YouTube channel was also produced this year.

Our second goal this year was to incorporate DEI centric initiatives in our recruitment and retention efforts. Several of our department members participated in residency recruitment events, such as the Specialty Speed Dating event at the SNMA Annual meeting, a pathology breakout session for the GME Second Look Event, and the annual National Hispanic Medical Association meeting. To reach younger students who may be interested in a career in Pathology, Karen Barron, Pathology Allied Health Education Manager, spearheaded departmental participation in events such as the Youth Summit at the Big House as well as community outreach events (such as career fairs and school visits) geared towards high school students. Finally, Drs. David Gordon and Julia Dahl are spearheading the creation and execution of innovative plans to better incorporate DEI centric initiatives into our residency recruitment and education.

Faculty & Staff Development

Laura Lamps, MD
Assistant Chair, Faculty & Staff Development

The office of the Assistant Chair for Faculty and Staff Development is responsible for the ongoing professional development of both faculty and staff throughout the Department of Pathology and faculty promotions and tenure attainment cycles.

In FY23, the promotions committee, made up of Drs. Laura Lamps (Chair), Doug Fullen and Nick Lukacs, met with junior faculty to discuss their goals and to help them prepare for and better understand the promotion and tenure process. Twelve faculty (*opposite page*) were identified as meeting criteria for promotion. Their promotion applications were all approved by the medical school, effective September 1, 2022. In addition, an additional eight faculty members were identified for the FY24 cycle and their promotion packets were completed and submitted to the medical school for review.

On the Allied Health Services front, Karen Barron, (Pathology Allied Health Education Manager), Kristina Martin (Clinical Pathology Operations Director), and Chris Rigney (Anatomic Pathology Operations Director) collaborated with Dr. Lamps on preparing and submitting a proposal requesting funding from Michigan Medicine leadership to support training programs for phlebotomists, medical laboratory scientists, and histotechnologists. The Department has faced ongoing challenges in recruiting qualified staff to fill open positions in these areas. These training programs would help to alleviate the ongoing staffing challenges and enable us to more readily fill open positions. The proposal was presented to Michigan Medicine leadership in October 2022, and revisions were requested. The revisions were completed and the proposal was resubmitted for further consideration. Ultimately, it was denied by Michigan Medicine leadership.

To further enhance our Allied Health staff development, Ms. Suzanne Butch, who served as a Medical Laboratory Scientist for many years in our department, established the Clinical Pathology Staff Enhancement Fund to support educational initiatives for clinical laboratory staff and clinical laboratory science/phlebotomy interns in the Department of Pathology. Donations were solicited from all faculty in addition to Ms. Butch's donation. For FY23, this fund was used to support the recertification expenses for our Medical Laboratory Scientist and Phlebotomy staff. These expenses were previously paid for by our staff, who greatly appreciated the financial assistance to maintain their certifications.

After consultation with junior faculty about what mentoring resources would be of use to them, a list of faculty willing to mentor junior faculty has been compiled, and is in the process of going live.

Professor


Sandra Camelo-Piragua, MD
Clinical


Tomasz Cierpicki, PhD
Tenure


Jolanta Grembecka, PhD
Tenure


Alexandra Hristov, MD
Clinical

Associate Professor


Richard Cantley, MD
Clinical


Jerome Cheng, MD
Clinical


Shih-Hon (Sean) Li, MD, PhD
Clinical


Dan Robinson, PhD
Research

Assistant Professor


Roberta Caruso, MD, PhD
Research


Miguel Quiros Quesada, PhD
Research


Douglas Rottmann, MD
Clinical


Mark Schultz, PhD
Research

Finance & Administration

Brooklyn Khoury
Director, Finance & Administration

David Golden
Interim Director, Finance & Administration

The Division of Finance and Administration, which is under the auspices of the Office of the Chair, is responsible for the business, operational, and fiscal affairs of the Department of Pathology, as mandated by the policies of the Chair, Michigan Medicine, and the University. In this section, key achievements of the Finance and Administration team are highlighted as well as the supporting services provided by this division. Mr. David Golden accepted the role of interim Chief Department Administrator in September 2021 after the unexpected passing of Mr. Martin Lawlor. David stepped into and provided administrative leadership to the Department while continuing his role as Director of Finance. David administratively oversees a combined annual expense budget of $260 Million and over $1.1 Billion in gross revenue.

Some key divisional highlights for this academic year include:

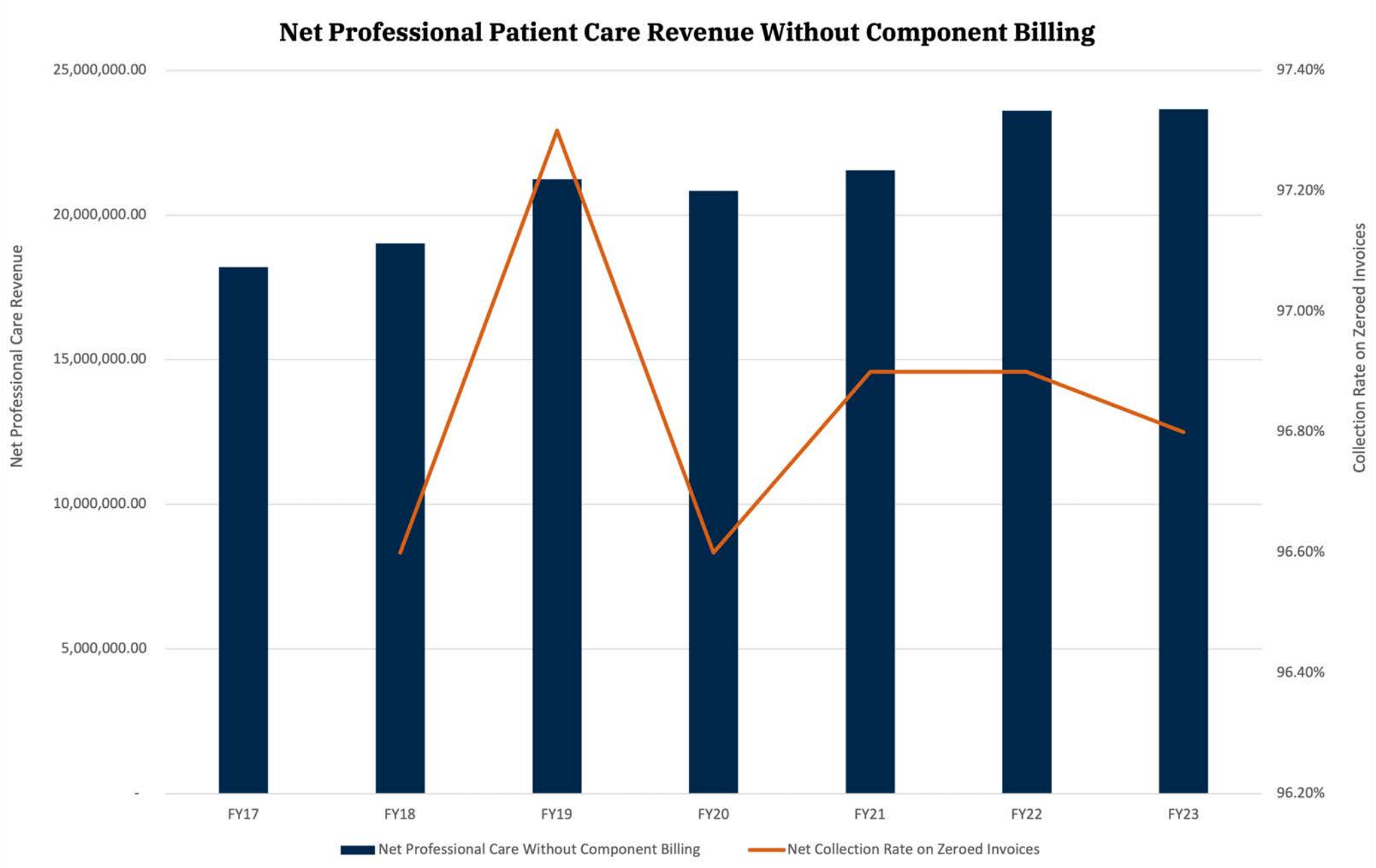
- Successfully integrated MMGL into the Department of Pathology.
- Addressed staffing shortages in our clinical laboratories and pathology informatics, reviewed all staffing requests and developed a good track record of getting them approved by senior leadership in UMHS. Pathology has over 1,000 staff and David reviews and approves all new and replacement positions in collaboration with the Medical Directors of the various divisions.
- Deployed labor market adjustments in January 2023 for select clinical staff and continue to work on further labor market adjustments to address compression issues.
- Developed and implemented cost reduction and margin improvement strategies to reduce our FY24 hospital operating budget based on directives from MM leadership.
- Worked closely with Dr. Parkos on several key faculty and staff recruitments and retention.
- Participated in the selection and hiring of a permanent Chief Department Administrator, Brooklyn Khoury, who started in June 2023.
- Completed our three-year forecast of faculty workforce plans.
- Developed a proposal to implement Digital Pathology in the Department in FY23.

The Division of Finance and Administration is divided into support services for the pathology laboratories; academic and business affairs; and human resources, faculty affairs, and education.

Pathology Laboratories

The administrative support center for pathology laboratories is responsible for the preparation and monitoring of all hospital laboratories' revenue, expense, and capital budgets, and personnel and payroll systems. During this period, total laboratory operating expenditures were $195 million. Staffing levels in the laboratories remained largely flat at 858 paid FTES. In part, this is a result of the nation-wide trend in technical staffing shortages. We developed several incentives to attract new hires as well as retain existing staff during the year. We are also looking at ways to develop staffing pipelines by partnering with local schools. Pathology is responsible for 9.0% of total hospital gross revenue and 3.7% of total expense. Gross revenue was up 3.7% when compared to FY22 despite COVID testing continuing to decline as the pandemic waned. Billed tests in FY23 were 7.3 million vs. 7.2 million in FY22. *(See pgs. 73 & 77)*

The administrative support center team worked diligently in FY23 as we continued the remodeling of the University Hospital clinical laboratories. The renovation of these spaces was paused during the early months of the pandemic but began again in earnest in the Summer of 2021. Led by the PRR team with the support of the Pathology Informatics team, the renovations


Net Professional Patient Care Revenue Without Component Billing
25,000,000.00
20,000,000.00
15,000,000.00
10,000,000.00
5,000,000.00
-
Net Professional Care Revenue
97.40%
97.20%
97.00%
96.80%
96.60%
96.40%
96.20%
Collection Rate on Zeroed Invoices
FY17
FY18
FY19
FY20
FY21
FY22
FY23
Net Professional Care Without Component Billing
Net Collection Rate on Zeroed Invoices

Mike McVicker
Administrative Manager, Clinical Operations

Kristina Andoni
Financial Analyst Senior, Medical School

Christine Shaneyfelt
Financial Analyst Senior, Hospital

proceeded on a modified schedule and without excess disruption. Throughout FY23, our facilities managers and the PRR team diligently addressed issues as they arose, especially with unanticipated issues surrounding logistics of maintaining clinical laboratory operations during the renovations.

Members of the administrative support center team served as departmental liaisons with nursing, the office of clinical affairs, office of clinical safety, biomedical engineering, and hospital finance. They served on the quality month committee, pathology diversity, equity, and inclusion committee, pathology patient and family advisory council, pathology social media committee, and others. The team addressed patient safety issues and cooperated on process improvement initiatives with partners such as the Rogel Cancer Center, UH operating rooms, and various medical procedure units.

Office of Academic and Business Affairs – Medical School

The office of academic and business affairs – Medical School, is responsible for all administrative and academic operations associated with the Department, including management of department finances (budgets, contracts, research grants, forecasts, and analyses), as well as clinical billing (professional and technical front-end operations). In collaboration with the Chair, Mr. David Golden implemented and directed strategic goals for Medical School operations including development of policy and business plans, management of faculty compensation and departmental funds, and use of departmental facilities, including modifications, renovations, and reassignment of department space.

The office also manages the Michigan Medicine and All Funds expenditures and forecast processes. Key departmental metrics include:

- Total Medical School All Funds expenditures including the MCTP for FY23 were $84 million and Hospital expenditures were $195 million.
- Hospital technical gross revenue for FY23 was $1.04 billion, compared to $1.00 billion in FY22, an increase of 3.7%.
- Professional fee gross charges were $95.3 million in FY23 compared to $91.1 million in FY22, an increase of 4.6% ($4.2 million).
- In FY23, our faculty received 53 awards from the NIH and ranked 7th in the nation in funding by the NIH, an improvement of our 8th place in FY22, and 3rd in the nation when considering the number of awards received. Total committed grants in FY23 was $31.6 million, an increase of 5.4% over FY22. Our total sponsored research spending in FY23 was $30.9 million, down from $36.4 million in FY22, a 15.2% decrease.

Business Affairs

Business Affairs is responsible for oversight of all accounting and financial transactions for the Department as well as ensuring appropriate hospital and medical school funds flows. Our billing office handles all send-out, component, and MLabs billing, and any interdepartmental, MLabs, or Hospital patient billing error corrections. The grants management office handles the day-to-day management of research funds to ensure compliance with funder requirements, and to ensure the funds are distributed appropriately both within Pathology as well as across internal and external research groups. Business Affairs is also responsible for Hospital and Medical School financial reporting and budget preparation for the Department and in administering numerous contracts. As part of the budgeting process, they develop and maintain the capital equipment process, prepare financial analyses, and produce numerous ad hoc reports. They also oversee the Pathology Renovation and Relocation project to ensure contract terms are met, budgets are managed, and capital investments are approved according to Michigan Medicine and Pathology procedures, and facilities are prepared for the renovation of University Hospital spaces that occurred in FY23. In addition, all faculty and staff effort and funding changes are processed through this unit.

Finance

The Department of Pathology is in a strong financial position and continues to thrive under the leadership of Dr. Charles Parkos and Mr. David Golden, with endowments and FFAE to support our clinical, research, and educational missions, exceeding $131.5 million. In FY23, we experienced a larger gap between

our revenues and expenses, with Revenues at $67.8 million, down 5.3% over FY22 and expenses at $84.0 million, down 1% over FY22, mostly due to the loss of the Wayne and Livingston County contracts and investments in our strategic priorities. This resulted in an operating loss of $16.2 million. The loss was offset by non-operating income (investments, dean's contributions, and other institutional support payments). Including our non-operating income, FY23 ended with a net loss of $4.6 million. In contrast, in FY22 we experienced a loss of $3.4 million.

Michigan Medicine has long-range expansion and upgrades planned, including Pathology's Renovation and Relocation Project, that require greater-than-average net budget increases as compared to those seen over the past decade. As a result, there is significant pressure on Departments to reduce expenses and increase revenues. Our patient care revenues continue to grow evidenced by our collection rate increasing from 24.4% of gross charges to 25.0% in FY23. Our group practice net collection rate on zeroed balances remains strong at 96.8%. Pathology faculty and staff paid FTEs have remained relatively flat at 1,216.9 in FY23 versus 1,210.7 in FY22. The combination of the pandemic and the economic constraints has forced us to do more with less staffing. As a result, filling vacant staff positions has become more difficult. We are grateful to our staff, who have stepped up to the plate to take on additional duties to ensure the missions of Pathology continue to meet and exceed expectations.

We have outstanding faculty and staff who continue to support exceptional scholarship and clinical care. Our clinical services continue to grow and maintain the highest quality. New educational opportunities continue to attract top trainees and our future looks bright as we move forward into our newest facilities, designed for the future. Overall, FY23 has been a tremendous year for our department.

Human Resources, Faculty Affairs, and Education

Our Staff Human Resources Team provides support for Pathology's hospital laboratories (approximately 857.8 FTEs) and Medical School support staff, including our research programs (approximately 212.3 FTEs). This includes processing all new hires, promotions, merit increases, orientation, as well as transfers when staff move to other departments, or terminations for those who leave our institution. They also help to coordinate employee recognition events and awards.

Faculty Affairs is responsible to coordinate appointments, reappointments, and promotions for our 189 active faculty and the 21 supplemental appointments in the Department. In FY23, ten new faculty joined the Department of Pathology while we bid farewell to nineteen faculty members. Twelve of our faculty successfully completed the promotion process (*see pg. 71*).

Our faculty received numerous awards in recognition of their achievements in academics, research, and clinical service. (*See Appendix on pg. 84*)

The Education Office includes the Residency and Fellowship Training Programs (26 residents and 18 fellows in 10 ACGME and 8 non-ACGME programs), the Medical Student Education Teaching Programs for the M1 and M2 laboratories, and the M4 Clerkship Program, as well as the Molecular and Cellular Pathology PhD program with 25 students actively pursuing their doctoral degrees. Management responsibilities are focused on curriculum management (including the Research Seminar Series), academic records, budget planning and financial operations, recruitment, and program activities, such as the annual departmental research symposium. The department also holds two NIH training grants (PIs Nicholas Lukacs, PhD; Andrew Lieberman, MD, PhD, Zaneta Nikolovska-Coleska, PhD) which support four pre- and six postdoctoral trainees.

Office of the Chair

The staff in the Office of the Chair coordinates the Advances in Forensic Medicine and Pathology conference, which was held in the spring of 2023. They also reconcile departmental procurement cards, renew medical licenses, process CME requests for faculty, coordinate and develop departmental communications including the *Inside Pathology* magazine and the annual report, and prepare numerous reports and presentations for various meetings. In addition, they provide support to the Chair and Chief Department Administrator, including scheduling, travel arrangements, data collection, event planning, correspondence, committee support, and faculty recruitment.

John Harris
Manager, Research Administration

Sarah Dudley-Short
Manager, Faculty Affairs

FY23 Pathology Income Statement		
Revenue	**FY22**	**FY23**
Patient Care Revenues	$23,922,185	$25,388,388
UMHS Service Payments	$8,149,368	$10,572,996
Net Total Research (Directs & Indirects)	$24,760,445	$21,380,199
Gifts and Other Income (Wayne/Washtenaw ME, etc.)	$9,588,329	$5,612,117
Total Revenue	**$66,420,327**	**$62,953,700**
Expenses		
Total Salaries	$55,374,180	$55,736,127
Total Non-Payroll Expense	$19,548,796	$18,337,528
Total Operating Expenses	$74,922,976	$74,073,655
Operating Margin (Loss)	**($8,502,649)**	**$(11,119,955)**
Non-Operating Income and Expense	$9,478,084	$11,252,130
(Includes Investment Income, UMHS Margin Sharing, Departmental Commitments, etc.)		
Total Margin	**$975,435**	**$132,175**

Community Service

In support of our mission as a non-profit healthcare provider, our faculty and staff engage in numerous service activities throughout the year. Some of the activities our faculty and staff engaged in this year included:

Local Activities (UM, Ann Arbor, Michigan)

- Relay for Life Teams to raise funds for cancer treatment
- Assisted MetroHealth in validating the Verify-Now assay for aspirin and Plavix-specific platelet aggregation
- Gift of Life Michigan board and committee memberships
- Patient and Families Advocacy Committee (PFAC)
- Numerous Medical School and Health System committee leadership/membership (see our list of new leadership positions)
- High school genetics, ethics, Doctors of the Future and other programs, as well as volunteering to coach or direct athletic programs
- High School Ethics Bowl judge
- Service on multiple non-profit boards of directors

National

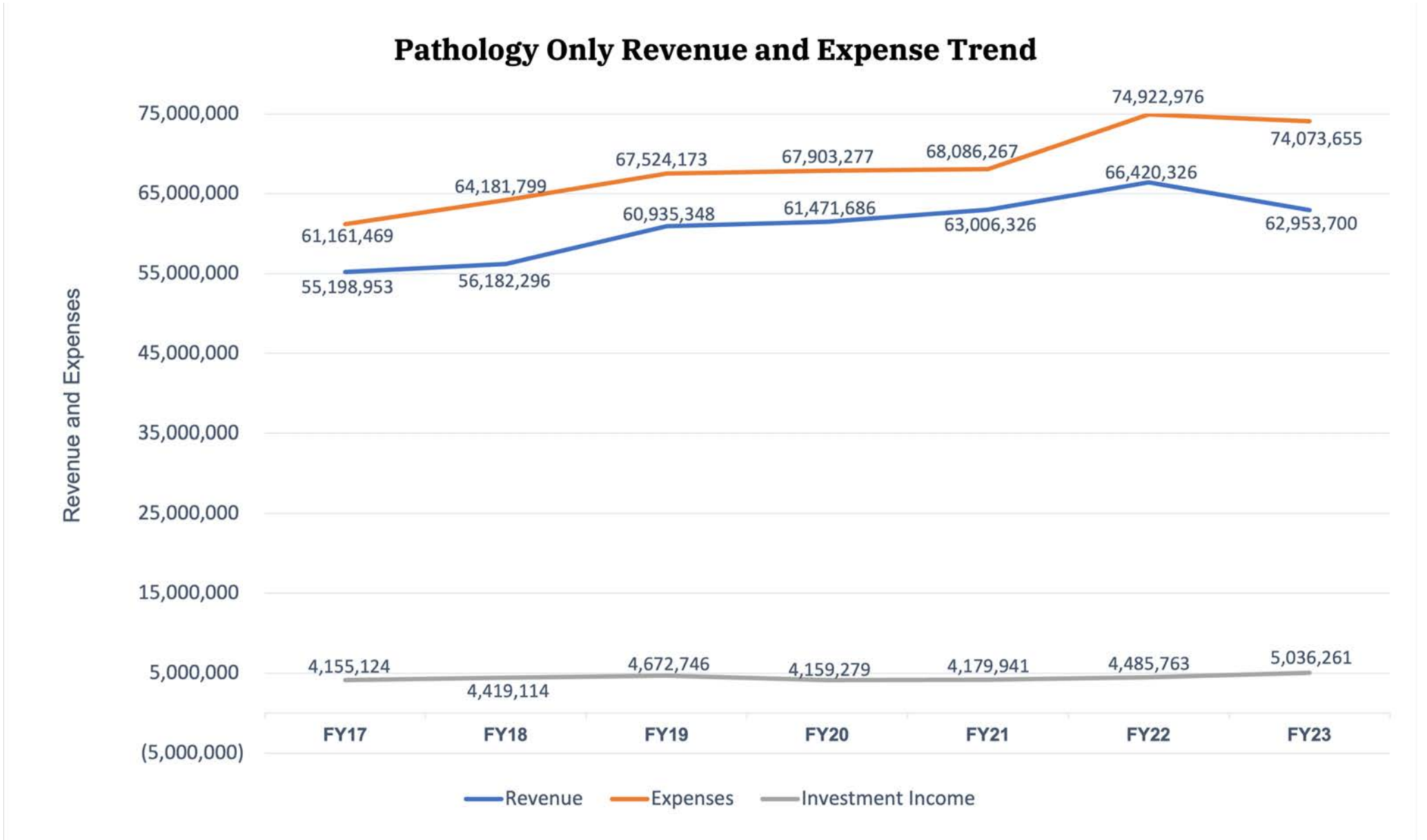
- Assisted in multiple inspections for College of American Pathologists (CAP), American Association of Blood Banks (AABB), American Society for Histocompatibility and Immunogenetics (ASHI)
- Serving on multiple national and international professional organization boards and committees *(See new leadership positions in the Appendix pg. 84)*

International

- Exploring transport solutions for patient samples in remote African villages to laboratory testing facilities
- Developing Essential Diagnostic Test List for low resource settings
- Implementing comprehensive 8-marker flow cytometry to accurately diagnose acute pediatric and adult leukemia patients in low-middle income countries, implementing it in Addis Ababa, Ethiopia
- Cervical cancer screening initiative in India

Employee Recognition

The Department of Pathology recognizes the valuable contributions made by our faculty and staff alike. In FY23, we recognized the years of service for faculty and staff who have served for 10, 20, 30, and even 40 years, as well as those who received Above and Beyond Awards, as nominated by their peers. *(Appendix pg. 86)* The number of employees who have been in the department for over 20 years speaks to the dedication of the employees as well as to the collegial atmosphere of our Pathology Department. This year we also honored our retirees. *(Appendix pg. 87)*


Pathology Only Revenue and Expense Trend
Revenue and Expenses
75,000,000
65,000,000
55,000,000
45,000,000
35,000,000
25,000,000
15,000,000
5,000,000
(5,000,000)
61,161,469
64,181,799
67,524,173
67,903,277
68,086,267
74,922,976
74,073,655
55,198,953
56,182,296
60,935,348
61,471,686
63,006,326
66,420,326
62,953,700
4,155,124
4,419,114
4,672,746
4,159,279
4,179,941
4,485,763
5,036,261
FY17
FY18
FY19
FY20
FY21
FY22
FY23
Revenue
Expenses
Investment Income

Pathology Relocation & Renovation Project

Christine Baker
Project Manager, Pathology Relocation & Renovation Project (PRR)

The Pathology Relocation and Renovation (PRR) Project is a multi-year, multi-phase project embracing the opportunities to relocate a large sector of the department into an offsite facility at the North Campus Research Complex (NCRC) and to renovate and right-size critical functions within University Hospital (UH). Christine Baker has been with the Department of Pathology for more than nine years and is the leader for this effort. She facilitates and manages the tasks needed to design and activate the new spaces and serves as the liaison to colleagues within Michigan Medicine Facilities and Operations as well as the construction teams led by the Architecture, Engineering, and Construction group.

Construction for Phase 1 of the PRR, which was over 140,000 square feet of newly renovated space at NCRC, finished in FY18. The activation of the new space started during the summer months and completed in November 2018. This included several major clinical laboratories as well as key administrative divisions.

Phase 2, the renovation of the laboratory and support spaces at UH, has five unique and distinct construction phases, with each construction phase followed by a period of activation. FY23 saw the completion and activation of the fourth phase of construction in Phase 2. This milestone included the opening and activation of the new Cellular Therapy Laboratory and associated office spaces, as well as the new Phlebotomy team room and cart storage room. The Point of Care Testing laboratory, which had temporarily moved to UH South earlier in the project, had a major upgrade of their spaces in UH South. This enabled this team to have their permanent home in UH South and allowed more space in the Core Laboratory for Pre-Analytical Automation. Two new Pre-Analytical Automation devices were added to the Specimen Processing zone within the Core Laboratory. This major addition of automation compliments the Chemistry and Hematology automation lines and facilitates quicker and more automated through-put of specimens. Additionally, a new employee break room was added to the UH Pathology footprint, creating a beautiful space for faculty and staff to have a break from the workday.

This year also saw numerous temporary moves to support on-going construction efforts. Following the Phlebotomy move to their new space, the Fine Needle Aspirate (FNA) team moved into their vacated space to allow for construction in UH South. Additionally, the education program moved to MBNI to allow for other construction projects to proceed. This program will ultimately reside in the former Phlebotomy space by the completion of the project.

During the past year, the faculty and staff within Pathology at University Hospital and UH South continued to work alongside major construction, shutdowns, sounds, and interruptions while maintaining continuous operations and providing outstanding service. It is a testament to their adaptability and sense of purpose that the Clinical Laboratory and patient care activities have not faltered nor had an interruption.

There is only one phase left in the completion of the PRR project. This phase includes office and support spaces in UH South, and the new Apheresis Patient Care Unit, FNA Team Room, and other employee support spaces in UH. The entire project is scheduled to complete in Spring 2024, culminating this ten-year endeavor.


Turner
ALEXIS MORENO

Anatomic Pathology Case Volumes	FY19	FY20	FY21	FY22	FY23	1-YR	5-YR
Cardiovascular Pathology							
Cardiovascular 1				120	369	207.50%	
Cardiovascular 2				226	620	174.34%	
David Gordon	166	217	445	209	0	-100.00%	-100.00%
Total	**166**	**217**	**445**	**555**	**989**	**78.20%**	**495.78%**
Cytopathology							
FNA by Pathologist with ROSE[1]	183	142	134	114	138	21.05%	-24.59%
FNA, No ROSE[1]	842	767	871	837	727	-13.14%	-13.66%
FNA, with ROSE[1]	2,102	1,788	2,048	2,243	2,510	11.90%	19.41%
Gyn Case1	23,580	18,608	24,384	24,630	23,810	-3.33%	0.98%
Non-Gyn Case	8,128	7,432	7,868	8,118	8,207	1.10%	0.97%
Total / 1 ROSE is Rapid On-Site Assessment	**34,835**	**28,737**	**35,305**	**35,942**	**35,392**	**-1.53%**	**1.60%**
Dermatopathology							
Derm In-House	15,979	13,470	15,733	15,038	15,606	3.78%	-2.33%
Derm Outside	7,400	6,518	6,382	6,761	6,421	-5.03%	-13.23%
MLabs Derm	9,748	7,549	7,979	8,644	8,292	-4.07%	-14.94%
Total	**33,127**	**27,537**	**30,094**	**30,443**	**30,319**	**-0.41%**	**-8.48%**
Hematopathology							
Hemepath In-House	2,301	2,659	3,674	3,598	3,647	1.36%	58.50%
Hemepath Outside	2,707	2,347	2,400	2,713	2,782	2.54%	2.77%
Total	**5,008**	**5,006**	**6,074**	**6,311**	**6,429**	**1.87%**	**28.37%**
Neuropathology							
MLabs Muscle	233	189	167	162	138	-14.81%	-40.77%
Muscle In-House	86	78	98	102	94	-7.84%	9.30%
Muscle Outside	36	29	22	37	25	-32.43%	-30.56%
Neuro In-House	834	741	786	761	818	7.49%	-1.92%
Neuro Outside	527	602	890	1,156	1,543	33.48%	192.79%
Total	**1,716**	**1,639**	**1,963**	**2,218**	**2,618**	**18.03%**	**52.56%**
Ophthalmic							
Ophthalmic In-House	1,455	1,367	1,397	1,462	1,451	-0.75%	-0.27%
Ophthalmic Outside	52	73	75	83	92	10.84%	76.92%
Total	**1,507**	**1,440**	**1,472**	**1,545**	**1,543**	**-0.13%**	**2.39%**
Pediatric and Perinatal Pathology							
Fetal Exams	230	215	256	257	240	-6.61%	4.35%

Peds Autopsy	27	24	24	28	23	-17.86%	-14.81%
Peds In-House	3,747	3,307	3,677	3,615	3,971	9.85%	5.98%
Peds Outside	477	407	408	456	445	-2.41%	-6.71%
Placentas	2,148	1,894	1,825	2,149	2,066	-3.86%	-3.82%
Total	**6,629**	**5,847**	**6,190**	**6,505**	**6,745**	**3.69%**	**1.75%**
Renal							
Renal In-House	1,413	943	811	859	1,172	36.44%	-17.06%
Renal Outside	59	43	34	52	86	65.38%	45.76%
Total	**1,472**	**986**	**845**	**911**	**1,258**	**38.09%**	**-14.54%**
Technical Only							
Technical Only	2,004	1,673	1,720	1,930	1,758	-8.91%	-12.28%
Technical with Interpretation	160	460	399	285	334	17.19%	108.75%
Total	**2,164**	**2,133**	**2,119**	**2,215**	**2,092**	**-5.55%**	**-3.33%**
Outside							
Breast	1,737	1,541	1,509	1,768	1,912	8.14%	10.07%
Cardiac	20	21	24	15	39	160.00%	95.00%
Cytology	1,196	1,192	1,076	1,223	1,192	-2.53%	-0.33%
Dermatopathology	7,400	6,518	6,382	6,761	6,421	-5.03%	-13.23%
Endocrinology	613	551	539	655	788	20.31%	28.55%
Gastrointestinal	5,220	5,043	5,108	5,548	5,873	5.86%	12.51%
Genitourinary	2,148	1,959	1,845	2,252	2,346	4.17%	9.22%
Gynecologic	1,696	1,571	1,520	1,735	1,914	10.32%	12.85%
Head & Neck	1,366	1,255	1,303	1,403	1,552	10.62%	13.62%
Hematopathology	2,707	2,347	2,400	2,713	2,782	2.54%	2.77%
InterDepartmental Consult	635	356	608	296	394	33.11%	-37.95%
Misc. Outside Case	22	9	6	1	5	400.00%	-77.27%
Muscle	33	29	22	34	25	-26.47%	-24.24%
Neuropathology	522	597	879	1,146	1,536	34.03%	194.25%
Ophthalmic	52	73	75	83	92	10.84%	76.92%
Pediatric	477	407	408	456	445	-2.41%	-6.71%
Pulmonary	3,184	2,712	2,564	2,962	2,960	-0.07%	-7.04%
Renal	59	43	34	52	86	65.38%	45.76%
Soft Tissue	1,630	1,481	1,696	1,830	2,110	15.30%	29.45%
Total	**30,717**	**27,705**	**27,998**	**30,933**	**32,472**	**4.98%**	**5.71%**

Table 1: *Anatomic Pathology Case Volumes 2018-2023 (From pg. 10)*

Clinical Pathology Billed Test Volumes	FY19	FY20	FY21	FY22	FY23	1-YR	5-YR
Clinical Chemistry and Toxicology							
Chemical Pathology	3,165,847	2,985,204	3,277,102	3,177,933	3,297,181	3.75%	4.15%
Special Chemistry	714,738	649,436	771,761	771,761	855,411	10.84%	19.68%
Total	**3,880,585**	**3,634,640**	**4,048,863**	**3,949,694**	**4,152,592**	**5.14%**	**7.01%**
Transfusion Medicine							
Blood Bank Bone Marrow	1,034	1,490	1,353	1,426	1,609	12.83%	55.61%
MM Pathology Blood Bank	327,245	326,459	335,100	323,820	330,983	2.21%	1.14%
Blood Procurement	66,414	59,056	66,279	60,800	59,254	-2.54%	-10.78%
Transfusion/Apheresis	2,008	2,132	1,238	2,015	2,057	2.08%	2.44%
Total	**396,701**	**389,137**	**403,970**	**388,061**	**393,903**	**1.51%**	**-0.71%**
Other Clinical Laboratories							
Path Heme/Coag Unit UH	1,268,568	1,227,916	1,293,850	1,319,143	1,348,313	2.21%	6.29%
Flow Cytometry Lab	105,598	99,902	101,981	101,563	103,741	2.14%	-1.76%
Cytogenetics Lab	12,313	11,709	14,249	16,315	16,192	-0.75%	31.50%
Histocompatibility	23,480	19,157	22,209	22,209	30,039	35.26%	27.93%
Microbiology & Virology	571,808	566,888	963,936	752,319	624,378	-17.01%	9.19%
Molecular Diagnostics	20,106	17,860	19,169	19,098	20,458	7.12%	1.75%
Path Reference Tests	151,392	141,665	145,234	164,397	172,953	5.20%	14.24%
Michigan Medical Genetics					**4,548**		
MCTP	393	248	283	549	27	-95.08%	-93.13%
Total	**2,153,658**	**2,085,345**	**2,560,911**	**2,395,593**	**2,320,649**	**-3.13%**	**7.75%**

Table 2 (Above): *Clinical Pathology Billed Test Volumes from 2019-2023 (From pg. 20)*
Table 3 (Right): *Transfusion Medicine data from 2019-2023 (From pg. 25)*

Tranfusion Medicine	FY19	FY20	FY21	FY22	FY23	1-YR	5-YR
Blood Bank Main Laboratory							
Red Blood Cells	33,065	31,040	34,340	31,838	32,248	1.29%	-2.47%
Random/Pooled Platelets	5,880	51	-	-	-	0.00%	-100.00%
Apheresis Platelets	11,000	13,640	16,193	15,992	15,984	-0.05%	45.31%
Plasma	7,073	6,676	8,144	5,974	5,275	-11.70%	-25.42%
Cryoprecipitate	7,840	6,676	4,504	7,090	7,205	1.62%	-8.10%
Total Components Transfused	**64,858**	**58,083**	**63,181**	**60,894**	**60,712**	**-0.30%**	**-6.39%**
Immunohematology Reference Lab							
Antibody Identifications	1,153	1,516	1,685	1,613	1,520	-5.77%	31.83%
ABO Resolution	233	312	258	262	301	14.89%	29.18%
BMT	319	284	298	246	615	150.00%	92.79%
Eulates	255	265	326	226	258	14.16%	1.18%
Adsorptions	402	547	318	388	252	-35.05%	-37.31%
Titers	477	484	616	568	616	8.45%	29.14%
Special Antigen Typing	6,137	6,384	7,097	6,948	6,420	-7.60%	4.61%
Total Activity / *Includes procedures not listed above	**10,624**	**11,402**	**12,619**	**11,920**	**12,647**	**6.10%**	**19.04%**
Cellular Therapies Laboratory							
Collections Processed	454	464	482	487	538	1.04%	6.80%
Bags Frozen	608	703	813	807	997	23.54%	63.98%
Transplants, Autologous	124	112	130	116	138	18.97%	11.29%
Transplants, Allogeneic	54	45	51	48	46	-4.17%	-14.81%
Transplants, Unrelated	75	71	58	57	46	-19.30%	-38.67%
CAR-T Products	34	30	38	44	51	15.91%	50.00%
Total Transplants	**253**	**228**	**239**	**221**	**230**	**4.07%**	**-9.09%**
Apheresis Service							
Therapeutic Plasmapheresis	1,310	1,416	1,334	1,302	1,324	1.69%	1.07%
HPC Collections	308	346	347	331	410	23.87%	33.12%
Donor Pre-Evaluations	308	236	202	253	298	17.79%	-3.25%
LDL Apheresis	94	95	62	76	52	-31.58%	-44.68%
RBC Exchange	170	175	199	244	243	-0.41%	42.94%
CAR-T Collections	33	20	40	44	52	18.18%	57.58%
Total Procedures	**2,223**	**2,288**	**2,184**	**2,250**	**2,379**	**5.73%**	**7.02%**

Faculty Awards FY23

Faculty	Award Name	Organization
Arul Chinnaiyan, MD, PhD	• Sjöberg Prize • Science of Oncology Award • Lifetime Achievement Award • Catchment Area Cancers Award	• Royal Swedish Academy of Sciences • American Society of Clinical Oncology • American Society of Indian Cancer Science Researcher • Rogel Cancer Center
Kathleen Cho, MD	2021 Rosalind Franklin Excellence in Ovarian Cancer Research Prize	Ovarian Cancer Research Alliance
Tomasz Cierpicki, PhD	2022 Rogel Scholar	Rogel Cancer Center
Jolanta Grembecka, PhD	Richard and Susan Rogel Professor in Cancer Therapeutics	University of Michigan
Celina Kleer, MD	2022 Rogel Scholar	Rogel Cancer Center
Rohit Mehra, MD	GUPS Award for Excellence in Uropathology Research	Genitourinary Pathology Society
Abhijit Parolia, PhD	• Junior Faculty Award • 2022 Harold M. Weintraub Graduate Student Award • 2021 Young Investigator Award	• American Society of Indian Cancer Science Researcher • Michigan Medicine • Prostate Cancer Foundation
Rajesh Rao, MD	Career Advancement Award	Research to Prevent Blindness
Lanbo Xiao, PhD	• Career Development Award • 2022 Young Investigator Award	• Michigan Prostate SPORE • Prostate Cancer Foundation

New National Leadership Positions FY23

Faculty	Role	Organization
Aleodor Andea, MD	Secretary/Treasurer	International Society of Dermatology
Noah Brown, MD	Chair, Molecular and Genomic Pathology Program	Association for Molecular Pathology
Sandra Camelo-Piragua, MD	Test Development and Advisory Committee for Neuropathology	American Board of Pathology
May Chan, MD	• Member, Test Development and Advisory Committee for Dermatopathology • Interim Section Head	• American Board of Pathology • Dermatopathology
Kathleen Cho, MD	Vice Chair, Membership Committee (Section 4)	National Academy of Medicine
Kristina Davis, MD	Co-Chair, Transplant Diagnostics Community of Practice	American Society of Transplantation
L. Priya Kunju, MD	Board of Directors	United States and Canadian Academy of Pathology
Zaneta Nikolovska-Coleska, PhD	• President • Member	• Interational Chemical Biology Society • Therapeutics Pipeline Advisory Committee, Ontario Institute for Cancer Research
Liron Pantanowitz, MD, MBA, MPH	Vice President	American Society of Cytopathology
Charles Parkos, MD, PhD	Board of Directors	Federation of American Societies for Experimental Biology
Lina Shao, PhD	Chair	American College of Molecular Genomics Lab QA Committee and Cytogenetics Subcommittee
Jiaqi Shi, MD, PhD	• Associate Editor • Standing Member, Mechanisms of Cancer Therapeutics Study Section	• Frontiers in Oncology • National Institutes for Health

New Department/Institutional Leadership Appointments

Faculty	Role	Area/Specialty
Ul Balis, MD	Co-Chair, Longitudinal Assessment Committee	Clinical Informatics Board
Scott Bresler, MD	Director	Dermatopathology Fellowship Program
Julia Dahl, MD	Division Director	MLabs
Simon Hogan, PhD	Co-Director	Molecular and Cellular Pathology Graduate Program
Evan Keller, DVM, PhD	Director of Researc Cores	Office of Vice President for Research
Annette Kim, MD, PhD	Division Director	Molecular and Genomic Diagnostics
L. Priya Kunju, MD	Division Director	Anatomic Pathology
Sean Li, MD, PhD	Interim Section Director	Transfusion Medicine
Rajesh Rao, MD	Member	A. Alfred Taubman Research Institute Executive Committee
Jeff Rual, PhD	Co-Director	Molecular and Cellular Pathology Graduate Program
Stephanie Skala, MD	Director	Surgical Pathology, and Histology and Frozen Section Laboratories

Table 4-5 (Left): *Faculty Awards FY23; New National Leadeship Positions FY23 from pg. 76.*
Table 6 (Left): *New Department Leadership Appointments FY23 from pg. 76.*

Inventions FY23

Invention Title	Inventors
Transepidermal Water Loss as an Anaphylaxis Monitoring Tool	Bridgette Kaul, Charles Schuler IV, Cristyn Zettel, James Baker Jr., Nicholas Lukacs
Epithelial-Mesenchymal Transition-based Gene Expression Signature for Kidney Cancer	Aaron Udager, Randy Vince Jr, Simpa Salami, Srinivas Nallandhighal
Kidney Cancer Gene Expression Signature	Marcin Cieslik, Rohit Mehra, Simpa Salami, Srinivas Nallandhighal, Todd Morgan
Diagnostic Biomarkers of Food Allergy and Anaphylaxis	Ankit Sharma, Simon Hogan, Sunil Tomar
Small Molecule Inhibitors of Pax2/5/8 Transcription Activation	Gregory Dressler, Shayna Bradford
Using AI Tools to Evaluate Genitourinary Tumors	Liron Pantanowitz, Rohit Mehra
Development of Primary Endometrial and Ovarian Cancer Cell Lines and Patient-Derived Xenografts	Analisa DiFeo, Michele Cusato
Discovery of a Highly Potent and Selective Dual PROTAC Degrader of CDK12 and CDK13	Arul Chinnaiyan, Xiaoju Wang, Yu Chang
Maresin 2 Encapsulated in Nanoparticles for use in Promoting Wound Repair	Aaron Morris, Asma Nusrat, Lonnie Shea, Miguel Quiros Quesada, Ryan Pearson
MSFragger-Core	Aleksey Nesvizhskiy, Andy Kong, Fengchao Yu
MSFragger-Glyco	Aleksey Nesvizhskiy, Andy Kong, Daniel Polasky, Fengchao Yu
IonQuant	Aleksey Nesvizhskiy, Fengchao Yu
MSFragger-LOS	Aleksey Nesvizhskiy, Andy Kong, Fengchao Yu
MSFragger-DIA	Aleksey Nesvizhskiy, Andy Kong, Fengchao Yu
Identification of DL78 as Targeted Anti-Mitotic Agent that Regulates Myc and can be used as a Therapeutic Target for Ovarian Cancer	Analisa DiFeo, Andrew White, Jessica McAnulty, Pil Lee
2-Hydroxybenzoic Acid Derivatives as Inhibitors and Degraders of Sirtuins	David Lombard, Nouri Neamati, Surinder Kumar, Yanghan Liu
Human I1061T NPC1 mice	Andrew Lieberman, Mark Schultz
Discovery of a Highly Potent and Selective Dual PROTAC Degrader of CDK12 and CDK13 and Their Derivatives	Arul Chinnaiyan, Jean Tien, Xiaoju Wang, Yu Chang

Table 7 (Above): *List of Inventions from pg. 46.*

Ongoing Clinical Trials/Studies Supported by MI-ONCOSEQ / 2023

NCT ID	Clinical Trial	PI	Total Patients	Sites
NCT05038332	UMCC 2021.046	Jackson	-	University of Michigan
NCT04140162	UMCC 2018.056	Ye	67	University of Michigan, Karmanos, University of Rochester, University of Texas Southwestern
NCT00261456	UMCC 2018.050	Alva	56	University of Michigan, Memorial Sloan Kettering, Johns Hopkins, Washington University St Louis, UCSF
NCT03456804	UMCC 2019.031	Heath	10	Karmanos
NCT03287050	UMCC 2017.069	Alva	6	University of Michigan
NCT03242915	UMCC 2017.057	Gadgeel	33	University of Michigan, Karmanos, Montefiore Medical Center, Rush University, Henry Ford, Cleveland Clinic
SU2C/PCF	VA Multisite	Chinnaiyan	254	University of Washington, University of Michigan, Karmanos, Royal Marsden Hospital
POPCAP-VA/PCF	Multisite	Alva	270	Ann Arbor VA, Bay Pines VA, Jesse Brown VA, James Haley VA
NCT03639935	UMCC 2018.044	Sahai	32	University of Michigan, Vanderbilt University
NCT04194554	UMCC 2019.117	Jackson	100	University of Michigan
NCT04748042	UMCC 2020.080	Reichert	21	University of Michigan
NCT03300505	UMCC 2017.055	Alva	10	University of Michigan
NCT04497038	UMCC 2020.007	Sahai	3	University of Michigan
NCT03785873	UMCC 2018.101	Sahai	34	University of Michigan Rogel Cancer Center, Cancer and Hematology Centers of Western Michigan, University of Utah, Virginia Mason, University of Wisconsin
NCT04203160	UMCC 2019.116	Sahai	85	University of Arizona Cancer Center, Northwestern University, Lurie Comprehensive Cancer Center, University of Michigan Rogel Cancer Center, Atlantic Health System University Hospitals - Seidman Cancer Center, Vanderbilt-Ingram Cancer Center, UT Southwestern–Simmons Comprehensive Cancer Center, Fred Hutch/University of Washington Cancer Consortium, University of Wisconsin - Carbone Cancer Center

Graduate Student Thesis Defense and Current Positions

Name	Defense Date	Thesis Title	Mentor	Position	Company
Hanjia "Angela" Guo	*August 5, 2022*	*Mechanisms of metabolic stress response induced by heart failure and cadmium toxicity*	David Lombard	Scientist, Epigenetics Applications Groups	Cell Signaling Technology

Table 8 (Above): *MI-ONCOSEQ Clinical Trials/Studies from pg. 37.*
Table 9: *Graduate Student Thesis Defense and Current Positions from pg. 56.*

Years of Service Recognition 2022

10 Years

Turquessa Brown-Krajewski	Sharon Kerr	Misty Sayer
Kelly Columbus	Christopher Lenton	Elsie Sedayao
Michele Cusato	Annette Leonard	Debra Sexton
Amy Drouillard	Emily Manion	William Sherman
Nancy Fritzemeier	Shannon McClintock	Gregory Simmons
Matthew Heilbronn	Susan Papa	Andrea Skiff
Shirley Hoffman	Krupa Patel	Irina Snell
Amanda Howard	Erica Rabban	Andrew Szczembara
Michele Hunter-Clark	Andrew Rasky	Cynthia Wang

20 Years

Jennifer D'Agostino	Yelena Kleyman	Jason Schwartzenberger
Kevin Forbing	Jianhong Liu	Teresa Thomas
Maria Gonzalez-Martinez	Kimberly Meekins	Christopher White
Chia-Mei Huang	Melissa Provost	Wei Zhao
Theotis Jones	Peggy Rost	

30 Years		40 Years
Brian Englehart	Michelle Herrst	Peggy Otto
Laura Gable		

Above and Beyond Award Recipients

Anatomic Pathology

Muntajib Alhaq	Danielle Hood	Threase Nickerson
Kelli Farhat	Kathryen Kearns	Sally Smith
Nancy Fritzemeier	Eric LaPres	Alexis Snyder
Casey Hollier	Cassandra Lee	Cortney Sullivan
Team Awards		
Histology	IPOS	Cytology Labs & Dr. David Keren

Clinical Pathology

Tierra Banks	Matthew Heilbronn	Alpa Patel
Jacquelyn Bates	Emily Hilliker	Yusuf Peaks
Ryan Boughton	Chrisopher Lenton	Hannah Riggs
Brenda Church	Sheridan Mattson	Jodi Smiley
Larry Clayton	Michele McGee	Rita Spiegelberg
Kayci Drake	Santana McIntyre	Renee Stoklosa
Marche Ellis	Michelle Merkel	Todd Teifer
Bradley Exell	Laverne Miner	Juan Torres
Chrstine Falkiewicz	Brandon Newell	Katherine Turner
Khaleel Geheim	Tifani Nicole	Dawn Wright
Joanne Guan	Kelly O'Brien	Hong Xiao
Zachary Harmon	Andrea Parkinson	
Team Awards		
Specimen Processing (Afternoon & Midnight Shifts)	Cancer Center Blood Draw Team	

Pathology Informatics

Andrea Hawk	Joshua Jacques	Sravan Kilaru
Ivan Holland	Jeremy Kendzorski	Brent Temple
William Hubbard		

Finance & Administration

Ashley Boguslaski	Regina Ferguson	Catherine Niemiec
Stephanie Edwards	Jennifer Mattison	

DQHI

Team Awards		
Keisha Beck	Christine Gaunt	Eleanor Mills
Michelle Garrasi	Tina Gray	Eric Vasbinder

MlLabs	Chair's Office	
Melinda Adler	Yvonne Beadle	Michal Warner
Jacquelyn Goodman	Angela Suliman	

Table 10 (Above): *Years of Recognition recipients from pg. 76.*
Table 11 (Right): *Retirees from years 2022-2023 from pg. 77.*

Retired 2022-2023

Name	Job Title	Date	Years
Douglas R. Fullen	Clinical Professor	*July 2022*	21
Jeffrey Harrison	Histotechnologist	*July 2022*	12
Michelle H. Bensette	Medical Technologist Spec	*August 2022*	34
Denise Ellul Sulavik	Pathologist Assistant	*October 2022*	14
Yinhong Shen	Medical Technologist	*November 2022*	22
Lena Mushkina-Livshiz	Medical Technologist Spec	*November 2022*	27
Lore Patricia Krzewina	Medical Technologist Spec	*December 2022*	18
Diana Khiterer	Allied Health Associate Supr	*December 2022*	28
David R. Lucas	Clinical Professor	*January 2023*	19
Nancy Lynn Tague	Histotechnologist	*January 2023*	18
Charles A. Howison	Laboratory Technician	*February 2023*	15
Jill T. Gosselin	Phlebotomist Specialist	*February 2023*	23
Rong Wu	Associate Research Scientist	*April 2023*	24
Nancy M. Czerwinski	Medical Technologist	*April 2023*	16
Sylvia Barbara Zelenka-Wang	Research Lab Specialist Inter	*May 2023*	32
Linda M. Dawson	Cytotechnologist	*May 2023*	29
Lori Lynn Hufstedler	Word Processing Operator Sr	*June 2023*	18
Laurie Chopko	Admin Asst Sr Healthcare	*June 2023*	33

Attendees at the 2022 Employee Recognition ceremony.

Retiree, Dr. David Lucas *(left)* photographed next to Department Chair, Dr. Charles Parkos during his retirement ceremony.

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Annual Report compiled by Pathology Communications: Lynn McCain, Editor; Anastazia Hartman, Editor; Brent Temple, Design and Layout; Bailey Fraker, Cover Design; Anastazia Hartman, Camren Clouthier, Dustin Johnston, and Elizabeth Walker, Photography. A special thanks to the many contributors who provided the content for this report.

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