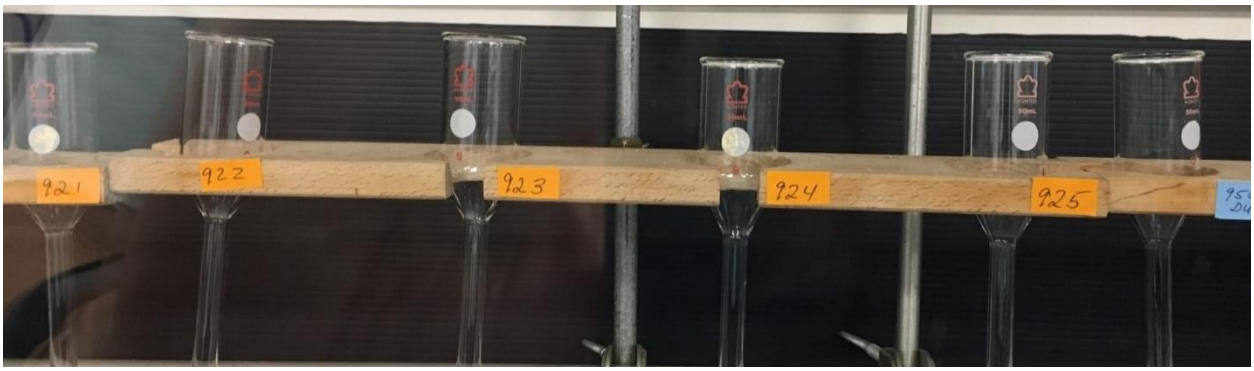
Fiscal Year 2018 Annual Report

Bureau of Laboratories



Bureau of Laboratories

Our Mission:

The Bureau of Laboratories is dedicated to continued leadership in providing quality laboratory science for healthier people and communities through partnerships, communication and technical innovation.

The Bureau of Laboratories is established under the provisions of revised Public Health Code – Act 368 of 1978, Part 96(3333.9601).

Our Vision:

The Bureau of Laboratories is a strong, more diverse team within an integrated public health system. We utilize advanced technology and innovative leadership to provide comprehensive public health services in our dynamic global community.

Sandip Shah, Ph.D., HCLD(ABB)
Bureau of Laboratory Director

Contents

Accomplishments

The Bureau of Laboratories participated in 150 proficiency test events from 10 different providers.

The Bureau of Laboratories along with the Bureau of Epidemiology and Population Health hosted Biosafety and Healthcare Preparedness conferences in Bay City and Plymouth.

Outreach hosted a laboratory science career workshop for college students introducing them to the public health laboratory.

The Bureau of Laboratories organized and hosted the "*South-Central Association of Clinical Microbiology"* meeting in September 2018.

In August 2017, the Bureau of Laboratories was designated as the National Tuberculosis Molecular Surveillance Center by Centers for Disease Control and Prevention to perform Whole Genome Sequencing in addition to Mycobacterial Interspersed Repetitive Units-Variable Number of Tandem Repeat testing for all 50 states to support outbreak detection and surveillance of drug resistance determinants of Tuberculous.

The Bureau of Laboratories Virology section was designated as one of four National Zika Confirmatory Testing Reference Centers.

The Bureau of Laboratories Virology section validated and began offering Hepatitis A Virus genotyping. This new in-house testing decreased turn-around time from four weeks to one week.

Analytical Chemistry developed an isotope dilution method for testing Perfluoroalkylated substances (PFAS) in water and serum.

Division of Infectious Disease successfully completed the Select Agent Inspection.

Analytical Chemistry tested over 700 fish tissue specimens and over 300 deer tissue specimens for PFAS.

Division of Infectious Disease introduced *"Lab 101*" courses for Local Health Departments.

Analytical Chemistry presented at the Annual Laboratory Response Network meeting in Boston, April 2018.

Division of Infectious Disease hosted five undergraduate students, two graduate students, one international student and provided a one-day molecular techniques course to undergraduate students.

Bureau of Laboratory employees provided over 20 external presentations, four posters presentations, authored seven manuscripts and four abstracts along with participating in numerous conferences during the course of the year.

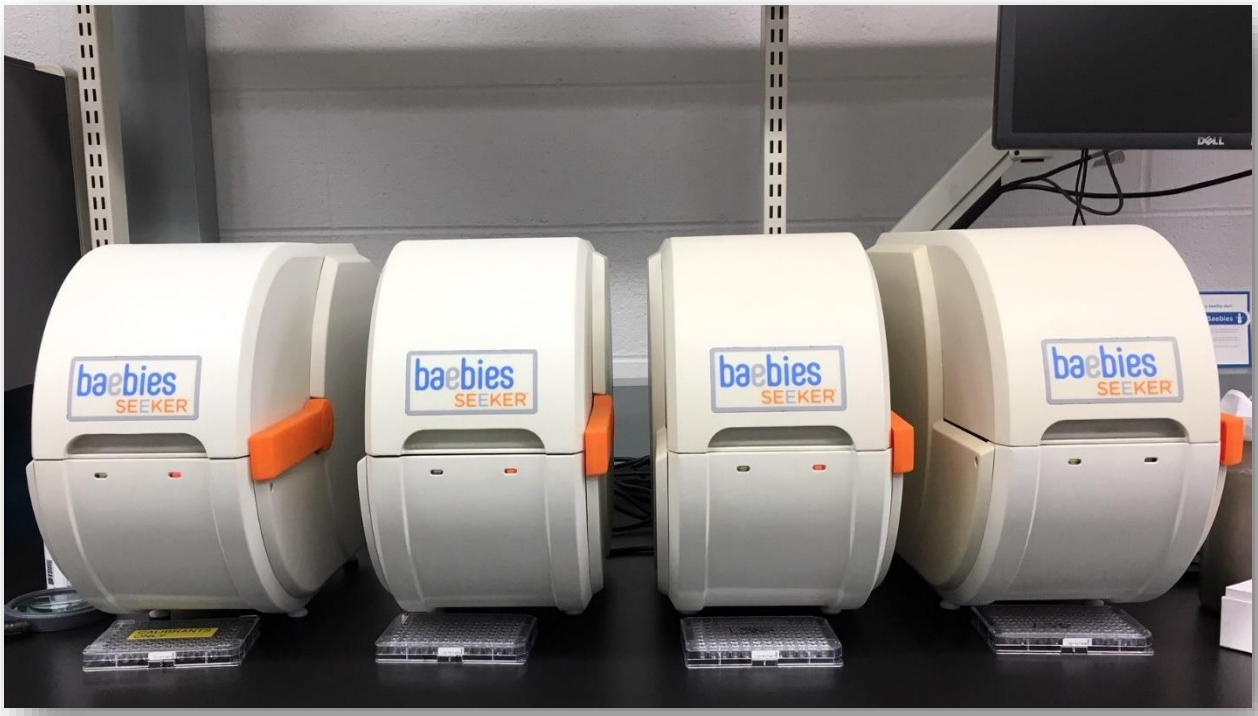
The Chemical Response Unit participated in two surge exercises for nerve agent metabolites. One exercise had 500 samples and the other had 10 samples.

Cutting-edge Technology for New Disorders in the Newborn Screening Laboratory

By: Harry Hawkins, Newborn Screening Laboratory Section Manager

Newborn Screening (NBS) is a public health program to test babies for over 50 rare but treatable disorders that are not always evident at birth. Laboratory testing is performed on filter paper, heel-stick and blood spots collected at 24 hours of age. The newest additions to the screening panel will be Glycogen Storage Disease Type II (Pompe) and Mucopolysaccharidosis Type I (MPS I).

Pompe and MPS I are two of approximately 50 metabolic disorders that result in lysosomal dysfunction. Lysosomal storage diseases (LSDs) are genetic disorders in which a mutation affects the activity of one or more enzymes. The normal metabolism of specific macromolecules is blocked, and the macromolecules accumulate inside the lysosomes causing severe physiological damage or deformity. Variability in enzyme activity leads to a broad spectrum of illnesses.



Pompe, an autosomal recessive disorder leads to a deficiency of acid α-D-glucosidase (GAA). The most severe infantile form can progress from hypotonia and cardiomyopathy to death within the first year of life.

MPS I, also an autosomal recessive disorder, is one of seven sub-types caused by a defect in the coding of α-L-iduronidase (IDUA) causing an accumulation of

glycosaminoglycoans (GAGS) in the lysosomes. These accumulations can affect many different organs and tissues. Severe MPS I can cause a rapid intellectual decline and development delay by age one.

The NBS laboratory is preparing to screen for Pompe and MPS I on a platform that is relatively new to newborn screening. Digital microfluidics, on the Baebies Seeker™, is a “lab on a chip” concept. This is the first FDA approved platform for lysosomal storage disorders for NBS. A single cartridge handles all of the steps of the analysis from sample preparation, processing, mixing, incubation, detection, and waste handling on the chip. The 3.5 µL dried blood spot eluate sample is pipetted onto the cartridge. A 200 nL droplet from each sample is sandwiched between two parallel plates filled with an immiscible oil. The top plate physically contains the droplet and the bottom plate contains programmable electrodes that can guide the droplets along the desired channel. The modulation of the interfacial tension between the droplet and the hydrophobic surface on the bottom plate can move the droplet. Software directed changes in the voltage advance the droplets through the various stages of the assay. The cartridges contain 48 wells for specimens, calibrators, and quality control samples. A workstation with four cartridges can test 480 samples per day.

Very few laboratories screen for LSDs using digital microfluidics. Michigan began reporting LSDs, Pompe, and MPS I in the fall of 2018.

Source: LabLink, Summer 2017, Vol. 22, No. 3

MICHIGAN
Newborn
Screening

National Tuberculosis Surveillance Center

The State of Michigan Bureau of Laboratories was selected to be the National Tuberculosis Molecular Surveillance Center by the Center for Disease Control and Prevention.

The State Laboratory performs whole genome sequencing (WGS) on each isolate from newly confirmed tuberculosis (TB) cases throughout the United States. WGS allows scientists to track the TB strains by their genetic make-up and look for changes that might indicate a new drug resistant strain.

Over 9,000 new cases of tuberculosis are diagnosed in the United States annually and approximately 130 new cases in the State of Michigan. TB is a respiratory illness that is spread when an infected person coughs or sneezes. TB usually infects the lungs but can affect other organs. Over the years TB has also developed drug resistant strains that make treating the disease a challenge.

The microbiologists at the state laboratory extract strands of deoxyribonucleic acid (DNA) from each new culture. The strands are broken into tiny pieces and each piece is tagged with an identifier. The sample is then placed in a DNA sequencer, an instrument that further breaks down the DNA into nucleotides. According to Dr. Marty Soehnlen, Director of Infectious Disease Division, “At the end of this process, it’s like a puzzle and the scientists will put it back together to identify the sequence, and from that sequence we can determine where something came from and if there’s antimicrobial resistance. It’s really an amazing process.”

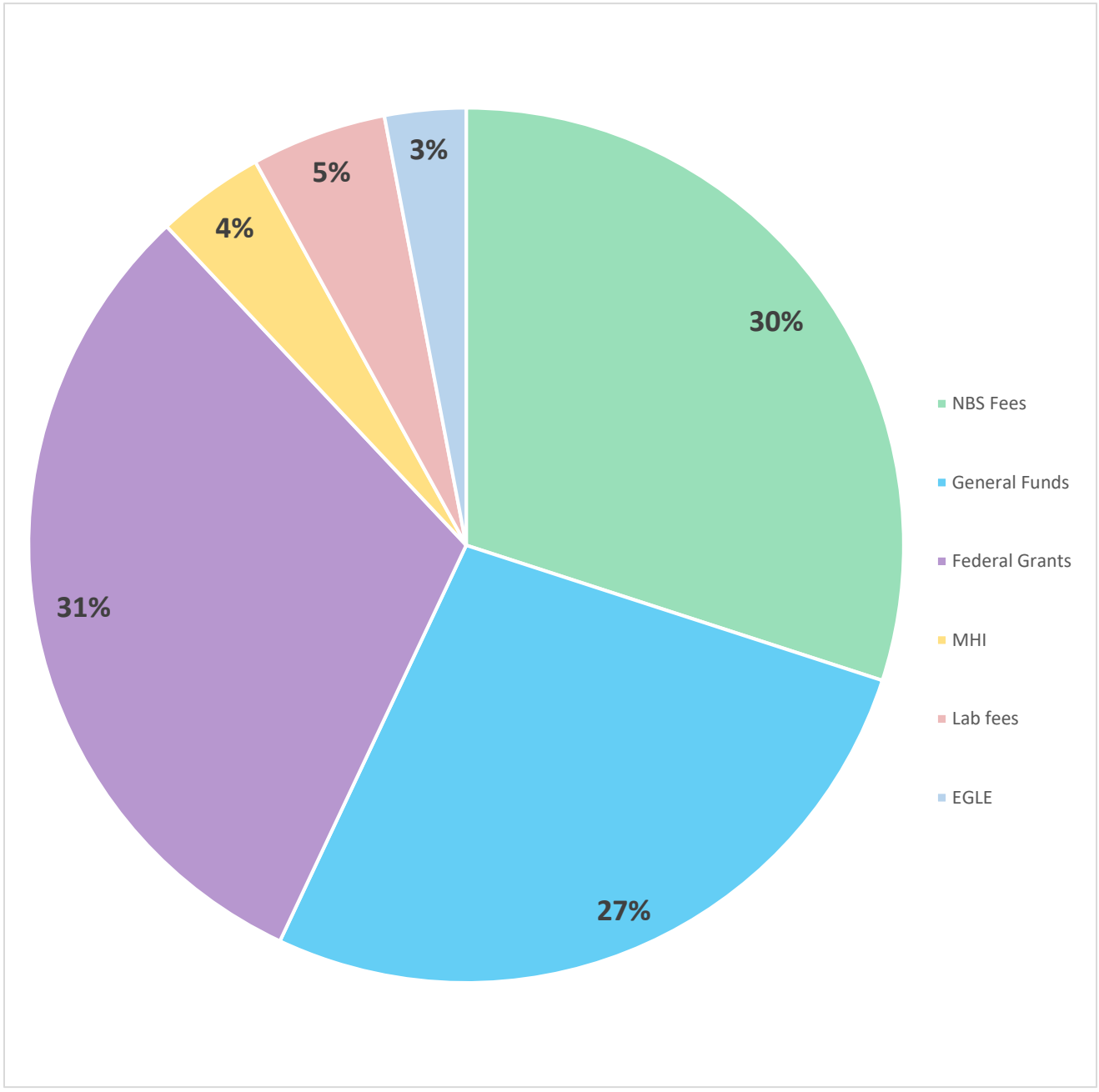
The United States has one of the lowest TB case rates in the world. The National Tuberculosis Molecular Surveillance Center with whole genome sequence testing will allow scientists to better track the disease, prevent its spread, and further reduce the number of TB cases every year.

References:
Michigan lab spearheads fight against tuberculosis, The Detroit News, Karen Bouffard, September 18, 2017.
Burden of TB in the United States, https://www.cdc.gov/features/burden-tb-us.

2018 By the Numbers

Bureau of Laboratory Services	Approximately 6.8 million tests were provided to State of Michigan residents	
Infectious Disease	120,545 specimens with 354,897 tests completed	Serving approximately 70,000 individuals
Newborn Screening	6,402,940 tests completed	Serving 108,249 newborns
Blood Lead/Environmental Lead	Over 30,000 specimens were tested for blood lead and environmental lead.	Serving approximately 18,000 individuals and households
Chemistry and Toxicology Division-Fish Testing	560 fish specimens tested for PCB, chlorinated pesticides and heavy metals.	Serving all residents of Michigan through the Eat Safe Fish Guide

2018 Funding Sources



Training and Tours

Tours:

- 48 hours in laboratory tours and visitor meet and greets

K-12 Outreach:

- Six career fairs reaching approximately 3,400 students
- 16 science demonstrations with approximately 2,200 students participating
- 16 college student interns volunteered to assist with K-12 outreach

Biosafety:

- Five in-house biosafety trainings held
- 12 hospital and university biosafety trainings completed
- Total of 325 people trained in biosafety
- Two regional Laboratory/Epidemiology meetings held
- One College Student Workshop held at the State Public Health Laboratory

Biological Threat (BT) Packaging & Shipping Training:

- 25 classes held throughout the state of Michigan
- Total of 297 participants certified in BT packaging and shipping

Chemical Threat Training:

- 10 classes held throughout the state of Michigan
- 79 participants from eight hospitals and Public Health Departments attended
- 137 participants in on-line course offered
- Four regional laboratory partners participated in a SPaSE event
- One tabletop training held for Michigan's Chemical Threat Response

Perfluoroalkylated Substances (PFAS) in Water: Method Development and Validation

By: Matthew Geiger, Director, Chemistry and Toxicology Division

For over 30 years, the State of Michigan has collected and analyzed fish from the state's bodies of water. These fish are tested for many contaminants of interest, including Perfluoroalkylated substances, or PFAS. The term "PFAS" is easily recognizable, within the State of Michigan, these days as an emergent environmental contaminant.

PFAS compounds are suspected as carcinogens, as well as endocrine disruptors, containing halogenated alkyl chains and a hydrophobic group, such as a carboxylic or sulfonic acid. What makes PFAS unique and highly marketable is that they can repel both hydrophobic and hydrophilic compounds, leading them to be commonly found in both industrial and consumer products. Because of their wide use throughout so many industries, they are commonly found as environmental contaminants. Another use of PFAS is in aqueous firefighting foams (AFFF), leading to the discovery of PFAS contamination near military bases. The main concern with these compounds is their structural stability and unlikelihood of decomposing naturally. Therefore, these compounds are of serious risk for bioaccumulation.

Recently though, the focus of PFAS contamination has shifted to water sources as another direct source of human exposure to PFAS. Measurable levels of two common types of PFAS, perfluoro-n-octanoate (PFOA) and perfluoro-1-octylsulfonate (PFOS) have been detected in various home water supplies around the State of Michigan. According to the State of Michigan PFAS Response Site (michigan.gov/pfasresponse), as of the fall of 2018, there were 34 confirmed PFAS contamination sites, including 10 which can be tied to active or former military facilities. Because of the high prevalence of known sites, and the likelihood of finding new PFAS sites, it is crucial for the State of Michigan to develop a water testing method for identification of these new sites.

The Analytical Chemistry section (AC section) was asked to develop a PFAS water testing method to provide analytical results to the Michigan Department of Environment, Great Lakes, and Energy (EGLE), and the Michigan Department of Health and Human Services (MDHHS) Division of Environmental Health so that environmental contamination can be measured, and human exposure understood. There are many types of water matrices (drinking water, surface water, ground water, effluent water) so it was the goal of the AC section to develop a PFAS water testing method that was capable of quickly analyzing many samples (high-throughput) and could be used for any type of water matrix. Through discussions, a core list of 24 PFAS analytes were determined to be of interest.

The AC section embraced the technological advancements in water extraction (advanced solid phase extraction (SPE) phases), automation TomTec 96-well plate sample preparation robot, and analytical instruments (Shimadzu 8060 LC-MS/MS) to create an efficient and accurate analytical method, capable of determining the concentration of PFAS in any water sample to a concentration of two parts-per-trillion (ppt). What makes this method unique is its automated SPE extraction of small volume (6 mL) water samples in a high-throughput format, coupled with near-baseline chromatographic separation of 24 Perfluorinated compounds, including the separation of linear/branched isomers, across a range of three-orders of magnitude (2ppt – 1ppb).

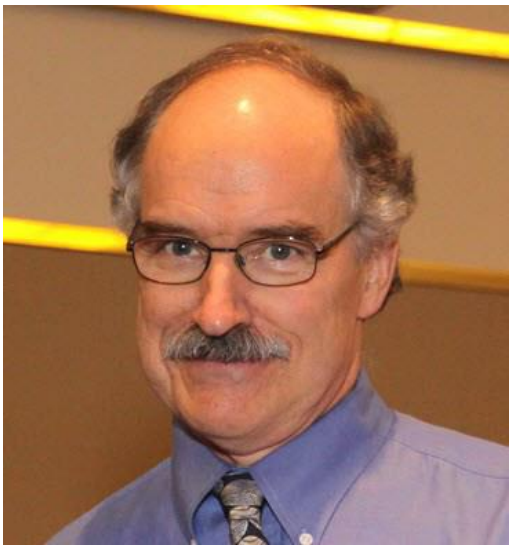
In addition to fish and water PFAS analysis, the lab is currently developing methods for PFAS analysis in additional matrices, such as venison and serum.

Source: LabLink, Fall 2018, Vol. 23, No. 3

Protocols Validated

16 test validations and verifications performed

Title of Protocol
Analysis of the Nitrogen Mustard Metabolites EDEA and MDEA in Urine by Automated 96-well Plate Solid Phase Extraction High Performance Liquid Chromatography Tandem Mass Spectrometry (SPE-HPLC-MS/MS)
Verification of the BioRad BioPlex 200 (SN LX10017178422) for Arbovirus (WNV, SLE & EEE) Testing
Comparison Study of TRF Ricin Plate Washers
Real-Time Multiplex PCR Assay for Detection of mcr-1 and mcr-2 using the ABI 7500 Fast DX or QuantStudio Dx
RT Polymerase Chain Reaction for the Detection of Cryptosporidium species extracted from fecal specimens
Comparability of 2 AB Verti Thermal Cycler systems (A-SN#299025103 and B - SN#2990235344) for 16S sequencing.
CDC approval to commence diagnostic testing for LRN Rickettsia RT-PCR Assay
Hepatitis A genotyping
Geenius APF v1.3 Software Upgrade (addendum to 16-200-015-244)
Real-Time Multiplex PCR Assay for Detection of mcr-1 and mcr-2 using the ABI 7500 Fast DX or QuantStudio Dx
RT-PCR Testing of Non-Respiratory Clinical Specimens for Mycobacterium tuberculosis complex and Mycobacterium complex DNA
Modified Carbapenem Inactivation Method (mCIM)
Verification for Biotek ELx800 Reader (SN 1711221A) for Dengue and Chikungunya IgM
Analysis of Human Blood for Cyanide by Head Space Gas Chromatography Mass Spectrometry
Molecular Determination of Serotype in Salmonella utilizing the Luminex xMSAP Salmonella Serotyping Assay
Analysis of Water Samples for Perfluoroalkyl Substances (PFAS) by Automated 96-well Solid Phase Extraction High Performance Liquid Chromatography by Tandem Mass Spectrometry (SPE-HPLC-MS/MS)



Leaving a Legacy of Saving Babies

By: Teresa Miller, Chemical Terrorism Response Training Coordinator

Harry Hawkins
1953-2018

In 2018, the Michigan Department of Health and Human Services Bureau of Laboratories lost a critical staff member and friend. Mr. Harry Hawkins, Newborn Screening Section Manager, passed away February 27, 2018. The Newborn Screening Program (NBS) is an important public health program designed to detect babies with rare, but serious disorders that benefit from early treatment. Mr. Hawkins played a vital role in the NBS Program since he started with the Michigan Department of Public Health in 1977 as a laboratory technologist. Later, he became the NBS Laboratory Section Manager.

Over the years, he has been instrumental in the growth of the NBS laboratory and advancing the laboratory from a completely manual process using one computer and results figured on calculators for a single disorder, to a highly automated, high throughput facility that screens for over 53 disorders daily using over 35 state of the art laboratory instruments, more than 100 computers and a sophisticated Laboratory Information Management System. His contributions included not only developing and standardizing assays but deploying automated computer data analysis and writing programs for data reduction.

Today, Michigan screens for over 53 disorders that can lead to severe morbidity or mortality if not detected early. As each disorder was considered for addition to the screening panel, Harry ensured use of the best available laboratory technology. The advancements of the Michigan NBS Program would not be possible without Harry's efforts and dedication. Although most families are unaware of his efforts over the last 3 ½ decades, he has touched the lives of approximately 7 million newborns who received screening, and his work has directly benefitted over 6,000 babies who have been identified with a disorder and referred for early treatment to help prevent serious health complications.

Harry's passion for newborn screening, his many years of successful collaboration, and lifelong public health career devoted to saving lives and improving the health of Michigan's newest infant citizens will be an inspiration for us all in the years to come.

Contact Us:

Michigan Department of Health and Human Services

Bureau of Laboratories

Phone: 517-335-8063

Fax: 517-335-8051

Email: MDHHSLab@michigan.gov