Cardiology in the Young

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In Memoriam

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In Memoriam: Paul Morris Weinberg, MD

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Abstract

On 15 October, 2020, Dr. Paul M. Weinberg, a true giant in the field of paediatric cardiology, succumbed to a prolonged illness. Dr. Weinberg had a 43-year career and was described as a pillar of The Children's Hospital of Philadelphia and the spirit of the Division of Cardiology, a cherished and beloved teacher, and an outstanding clinician. His impact on the field and on the careers of his students will be remembered for generations to come.

In 2019, Dr. Weinberg wrote for Jefferson Medical School's 50th year reunion memory book: "In the true spirit of Hippocrates, I seek to mentor the next generation as I was mentored by the last, without expectation of reward. I am forever indebted to these educators for all the knowledge they imparted to me and for the wisdom that I acquired under their tutelage." These words are a true reflection of his unassuming dedication to teaching the next generation of paediatric cardiologists. His legacy will continue to live on through these trainees and impact the field for generations to come.

On 15, October, 2020, Dr. Paul M. Weinberg (Fig 1), a true giant in the field of paediatric cardiology, succumbed to a prolonged illness. Dr. Weinberg had a 43-year career and was described as a pillar of The Children's Hospital of Philadelphia and the spirit of the Division of Cardiology, a cherished and beloved teacher, and an outstanding clinician. His impact on the field and on the careers of his students will be remembered for generations to come.

Dr. Weinberg grew up in Levittown, Pennsylvania, the oldest of three children. There is a wonderful series of photographs of him as a 3 year old examining his own mother with a stethoscope, auscultating diligently, and measuring her blood pressure and pulse (Fig 2). His family knew early that medicine was going to be his career path. He attended the combined Penn State/Jefferson Medical College 5-year programme, where in the first week he met the love of his life, Linda Levin Weinberg, who was also enrolled in that programme and to whom he was married for 53 years (Fig 3). After graduation, they moved to Philadelphia, where Dr. Weinberg completed his paediatric residency and paediatric cardiology fellowship at The Children's Hospital of Philadelphia. For the next 2 years, he served as a lieutenant commander in the Navy in San Diego as a paediatric cardiologist, before returning to the Northeast. He developed a passion for cardiac morphology and pathology from several mentors during his cardiology training, and he completed an additional fellowship in cardiac morphology with Drs. Richard Van Praagh and Stella Van Praagh at Boston Children's Hospital (Fig 4) before returning to The Children's Hospital of Philadelphia in 1977 for a faculty position in the Division of Cardiology. He became Full Professor of Pediatrics and Pathology in 2001, and he became Emeritus Professor in 2016.

In his long career at The Children's Hospital of Philadelphia, Dr. Weinberg was an esteemed clinician with expertise in general cardiology, cardiac morphology, and cardiac magnetic resonance imaging. He pioneered the cardiac magnetic resonance imaging programme, which is presently one of the largest in the country, leading the nation in the techniques of three-dimensional reconstruction. He also organised and directed the Cardiac Registry at The Children's Hospital of Philadelphia, which houses over 3000 cardiac specimens, with a spectrum of congenital and acquired cardiac disease. In his role as cardiac pathologist, Dr. Weinberg oversaw the preservation of specimens and personally performed the dissections on all new cardiac specimens. His opinion to review and dissect cardiac specimens was sought from all over the United States of America. On a weekly basis, Dr. Weinberg meticulously and methodically performed dissection conferences that were attended by cardiology and pathology trainees, visiting residents, and medical students. In these conferences, Dr. Weinberg reviewed the patient's history and images, demonstrated their anatomy, and often helped clarify their cause of death.

One of his greatest contributions to the Division of Cardiology was his role as Fellowship Programme Director for 24 years. Over that time, he trained over 145 cardiology fellows, many of whom went on to become leaders of our field in education, research, innovation, and clinical expertise. He also directed the paediatric cardiology curriculum for Penn medical students, where he engaged cardiology fellows as teachers in small group learning.



Figure 1. Paul Morris Weinberg, MD.



Figure 2. Paul M. Weinberg, MD at the age of 3 years examining his own mother with a stethoscope, auscultating diligently, and measuring her blood pressure and pulse.

His leadership in medical education went beyond The Children's Hospital of Philadelphia. He held leadership roles in the Society of Paediatric Cardiology Training Programme Directors, including the position of President, and spearheaded the Task Force on Clinical Competence for Paediatric Cardiology Training Guidelines, including in non-invasive cardiac imaging; these seminal documents were published in Circulation and the Journal of the American College of Cardiology.[1–5] He worked tirelessly on the fellowship curriculum, making it the much sought after programme that it is today.



Figure 3. Paul and Linda Weinberg at their wedding.

Dr. Weinberg also made significant research contributions, including over 140 peer-reviewed publications and book chapters. His early work focused on descriptions of tricuspid atresia,[6–10] vascular rings,[11,12] and one of the first reports of anomalies of the coronary arteries in hypoplastic left heart syndrome.[13] Later work described cardiac magnetic resonance imaging[14] of the pulmonary arteries in stages of functionally univentricular palliation,[15] airway obstruction from vascular abnormalities,[16] and atrial switch pathways in transposition of the great arteries.[17]

In January 2003, Dr. Weinberg became one of the original twelve members (Table 1) of the "*Nomenclature Working Group*" (*NWG*), a committee which eventually formed *The International Society for Nomenclature of Paediatric and Congenital Heart Disease (ISNPCHD)* [www.ipccc.net].[18–33] Paul joined the *Nomenclature Working Group* at its second meeting in Montreal in January 2003 (Fig 5) and enthusiastically participated in multiple meetings of The International Society for Nomenclature of Paediatric and Congenital Heart Disease around the world (Figs 5–10).

Cardiology in the Young is the official journal of The International Society for Nomenclature of Paediatric and Congenital Heart Disease, and Dr. Weinberg was a member of both the Editorial Board of *Cardiology in the Young* as well as the Board of Directors of The International Society for Nomenclature of Paediatric and Congenital Heart Disease. Dr. Weinberg was also a member of the Editorial Board of *The World Journal for Pediatric and Congenital Heart Surgery*. One of his important roles in The International Society for Nomenclature of Paediatric and

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Table 1. Initial membership of The International Working Group for Mapping and Coding of Nomenclature for Paediatric and Congenital Heart Disease (also known as The Nomenclature Working Group), which was the first committee of the International Society for Nomenclature of Paediatric and Congenital Heart Disease

1. Vera Aiello, *University of São Paulo Medical School, São Paulo, Brazil*
2. Marie J. Béland, *The Montreal Children' Hospital, Montreal, Canada*
3. Steven Colan, *Boston Children's Hospital, Boston, Massachusetts, United States of America*
4. Rodney C. G. Franklin, *Royal Brompton & Harefield Hospital NHS Foundation Trust, London, United Kingdom*
5. J William Gaynor, *The Children's Hospital of Philadelphia, Philadelphia, Pennsylvania, United States of America*
6. Jeffrey P. Jacobs, University of Florida, Gainesville, Florida, United States of America
7. Otto Krogmann, Heart Center Duisburg, *Duisburg,* Germany
8. Hiromi Kurosawa, Tokyo Women's Medical University, *Tokyo,* Japan
9. Bohdan J. Maruszewski, *Children's Memorial Health Institute, Warsaw, Poland*
10. Giovanni Stellin, *Universita di Padova, Italy*
11. Christo I. Tchervenkov, *The Montreal Children' Hospital, Montreal, Canada*
12. Paul Weinberg, *The Children's Hospital of Philadelphia, Philadelphia, Pennsylvania, United States of America*

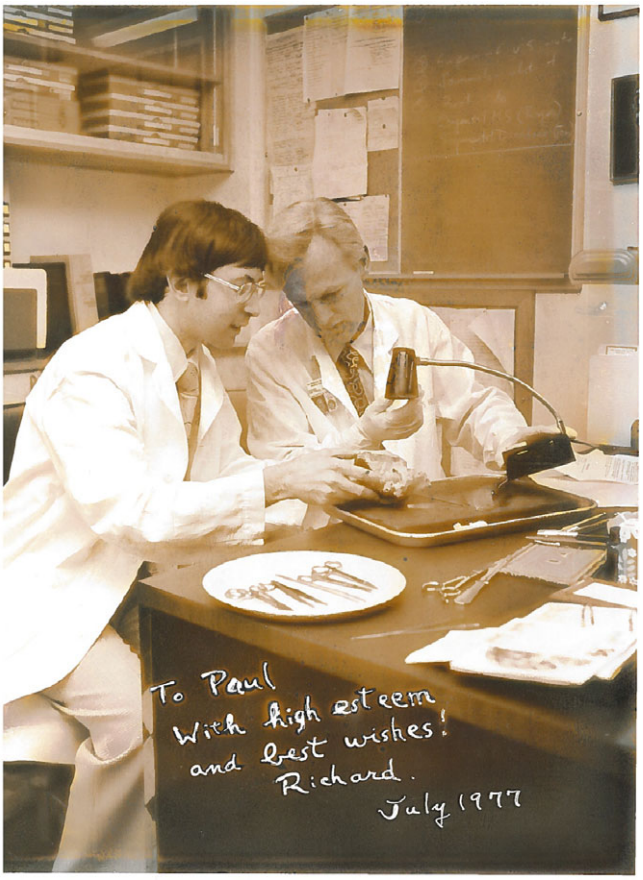


Figure 4. A young Paul M. Weinberg, MD studying under the tutelage of his mentor, Richard Van Praagh in July 1977.

Congenital Heart Disease was to help develop consensus between the Van Praaghian/Weinberg approach and the Andersonian approach to congenital cardiac nomenclature. The mapping of these complementary approaches forms the foundation of The International Paediatric and Congenital Cardiac Code [www.ipccc.net],[32] an achievement that would not have been possible without him.



Figure 5. Paul M. Weinberg, MD and members of the Nomenclature Working Group engaged in the detailed work of cross mapping at the second meeting of The International Working Group for Mapping and Coding of Nomenclatures for Paediatric and Congenital Heart Disease (Nomenclature Working Group), Hotel Versailles Park Plaza, 1808 Sherbrooke Street West, Montréal, Canada, 17,18, and 19th of January, 2003. Pictured from left to right are: Rodney Franklin, Bill Gaynor, Bohdan Maruszewski, Jeff Jacobs, Otto Krogmann, Christo Tchervenkov, Giovanni Stellin, Steve Colan, Paul Morris Weinberg, Vera Aiello, and Marie Béland.

Dr. Weinberg provided important leadership and devoted hundreds of hours to the research of "*The Nomenclature Working Group*" (*NWG*), and *The International Society for Nomenclature of Paediatric and Congenital Heart Disease* (*ISNPCHD*). Meetings of the NWG and ISNPCHD were typically held in a dark room, where members spent hours debating the nomenclature and classification of congenital heart disease. Dr. Weinberg often travelled to these meetings accompanied by his wife Linda. Paul and Linda were loved by all members of ISNPCHD, and their participation in the full spectrum of international social activities of ISNPCHD was substantial and notable. All members of ISNPCHD are deeply indebted to Paul for his vast contributions to its projects over these past 18 years.[18–33] We will always remember his gentle and humble demeanour and his superlative teaching abilities. An ever-smiling friend, mentor and scholar, he will be dearly missed.

Of all of Dr. Weinberg's extraordinary achievements, his contributions to medical education were the most impactful. His weekly pathology conferences were legendary. Over 90 minutes, he would review a cardiac lesion in detail in a slide presentation that often included remarkable figures and movies depicting embryology and how cardiac defects develop. No one who attended these conferences will ever forget his "donut analogy" in reference to conal anatomy to determine which great artery sits in the more anterior position! After the didactic lecture, he would famously strap on his headlamp and review the variations of that lesion using pathologic cardiac specimens from the Cardiac Registry. He knew all the specimens by heart and often told the medical history of the child that was so pertinent to our understanding of the disease. He had tremendous patience with his learners. He was never tired of answering our questions about anatomy, and you could always see a gleam in his eye when doing so. His dedication to the weekly pathology conference was so profound that even when he was critically ill in the hospital for 10 weeks, he insisted on giving his Thursday pathology lectures,

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Figure 6. Paul M. Weinberg, MD and members of the Nomenclature Working Group take a break from the research and go boating on Zyzdroj Lake in the Mazurian Lake District in Poland during the 5th meeting of The International Working Group for Mapping and Coding of Nomenclatures for Paediatric and Congenital Heart Disease (Nomenclature Working Group), Kanu Club Hotel, Zyzdroj Lake, Nowy Zyzdroj, Mazurian Lake District, Poland, 19th–23rd of July, 2004. Photo taken on 21 July, 2004. Paul Weinberg was always eager to participate in all the activities and excursions organised by the local hosts of the meetings of The International Society for Nomenclature of Paediatric and Congenital Heart Disease. Pictured from left to right are: Vera Aiello, Jeff Jacobs, Hiromi Kurosawa, Giovanni Stellin, Bohdan Maruszewski, Otto Krogmann, Christo Tchervenkov, Bill Gaynor, Paul Morris Weinberg, Marie Béland, Rodney Franklin, Tom Spray, and Steve Colan.

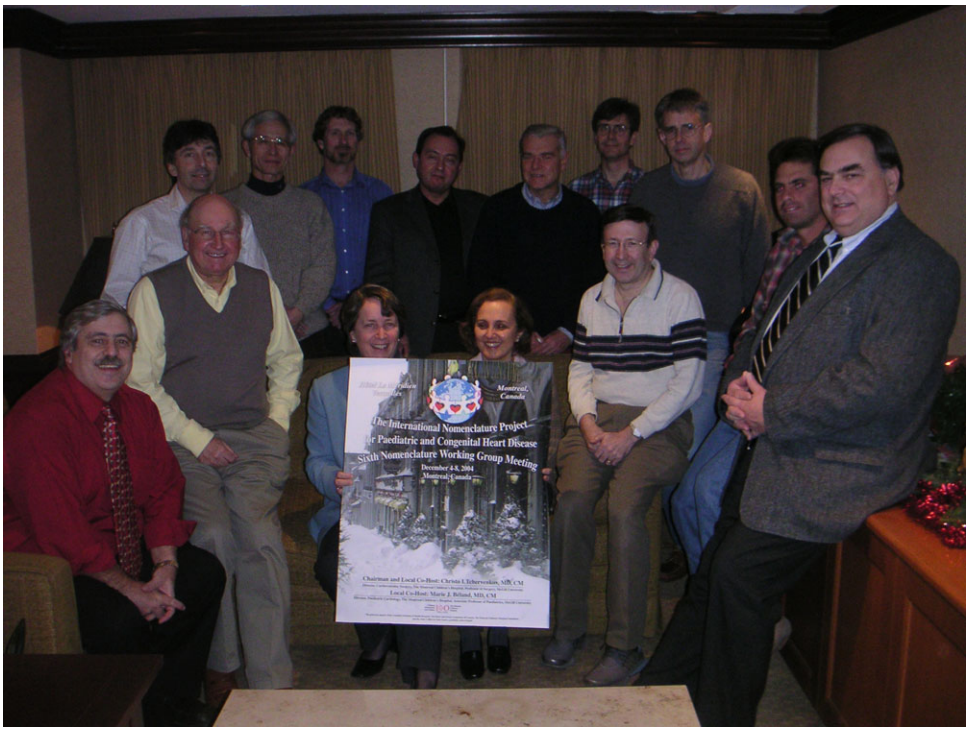


Figure 7. Paul M. Weinberg, MD and members of the Nomenclature Working Group at the 6th meeting of The International Working Group for Mapping and Coding of Nomenclatures for Paediatric and Congenital Heart Disease (Nomenclature Working Group), Hotel Versailles Park Plaza, 1808 Sherbrooke Street West, Montréal, Canada, 4th–8th December, 2004. Pictured from left to right are: Christo Tchervenkov, Professor Bob Anderson, Rodney Franklin, Hiromi Kurosawa, Steve Colan, Marie Béland, Bohdan Maruszewski, Vera Aiello, Giovanni Stellin, Otto Krogmann, Paul Morris Weinberg, Bill Gaynor, Jeff Jacobs, and Marshall Lewis Jacobs.

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Figure 8. Paul and Linda Weinberg attended the 9th Meeting of The International Working Group for Mapping and Coding of Nomenclatures for Paediatric and Congenital Heart Disease (Nomenclature Working Group), Keio Plaza Hotel [http://www.keioplaza.com/index.html], Tokyo, Japan Saturday 7 July, 2007–Thursday 12 July, 2007. This photograph shows Paul & Linda Weinberg with hosts Hiromi & Satoko Kurosawa.



Figure 9. Paul M. Weinberg, MD and members of The International Society for Nomenclature of Paediatric and Congenital Heart Disease at the ISNPCHD 2014 Annual Meeting. This meeting was held at Bellairs Research Institute of McGill University, Holetown, Barbados. This meeting included the 14th Nomenclature Working Group Meeting, the 6th Definitions Working Group Meeting, and 4th Archiving Working Group Meeting, 28 December, 2013 to 3 January, 2014. During this meeting, the topic of nomenclature, classification, and definitions of ventricular septal defects were debated extensively in the appropriately named village of Holetown, St. James Parish, Barbados! The International Society for Nomenclature of Paediatric and Congenital Heart Disease celebrated THE NEW YEAR together in Barbados!!!. Pictured from left to right are: Vera Aiello, Amy Juraszek, Bill Gaynor, Rodney Franklin, Jim St. Louis, Marie Béland, Frédérique Bailliard, Hal Walters, Leo Lopez, Paul Morris Weinberg, Steve Colan, Chuck Shepard, Lucile Houyel, Jeff Jacobs, Stephen Seslar, and Jorge Giroud.

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Figure 10. Paul M. Weinberg, MD and members of the International Society for Nomenclature of Paediatric and Congenital Heart Disease at the ISNPCHD 2019 Annual Meeting in Montréal, Canada. After the launch of ICD-11 in 2018, The International Society for Nomenclature of Paediatric and Congenital Heart Disease returned to its origins in Montréal, to discuss our next project, The IPCCC ICD-11 Congenital Heart Atlas. While in Montréal, the most adventurous members of The International Society for Nomenclature of Paediatric and Congenital Heart Disease got lessons in the sport of curling, and Paul Weinberg and Hiromi Kurosawa proudly received the highest marks. Paul M. Weinberg, MD is on the far left of this picture.

including his final lecture on hypoplastic left heart syndrome, given in late September 2020. In his hospital room, he put on his street clothes and gave his final talk to a group of devout and enthusiastic learners hanging on to his every word. He never mentioned that he was in the hospital or that he was so ill.

Dr. Weinberg was more than just an outstanding cardiac morphologist; he was also a master clinician. For over 50 years, he cared for patients with complex structural cardiac disease, and many of us had the opportunity to work with him on the wards and in the clinics. His experience as a clinician truly set him apart from other morphologists. He was a humble and kind physician, and the patients and their families adored him. He rarely ordered echocardiograms, because he could collect all of the information required with his eyes, hands, and stethoscope. For the first part of his career, he performed diagnostic cardiac catheterisations. The story is told of how he performed a catheterisation on a baby with a complex ventricular septal defect, whom he preferred to keep unsedated. After arranging the cameras in position, he gently calmed the baby with a toy and took the angiogram, which perfectly profiled the ventricular septal defect in the first shot. He achieved this precision because he understood the anatomy like no other. His experience in the clinics, cardiac magnetic resonance imaging, and the catheterisation laboratory beautifully synthesised with his work in cardiac morphology.

In a group of vociferous, often opinionated cardiologists and cardiac surgeons, the room would quiet when Dr. Weinberg chose to speak in surgical conference. You always knew you were going down the wrong path in the description of an echocardiogram, catheterisation, or magnetic resonance imaging if you saw him shaking his head in the front row. Then, he would calmly but compellingly correct your mistake and help you understand the reasoning. There is mantra that a single paediatric cardiologist could not have seen every single lesion; however, Dr. Weinberg came as close as anyone. His expertise in anatomy and morphology impacted the way we cared for patients and the surgical and interventional strategies we chose. He was a generous man, who was always willing to share his wealth of knowledge. He always did this with kindness and patience, no matter how basic the question may have been.

For those outside The Children's Hospital of Philadelphia community, Dr. Weinberg organised an annual 5-day course on Advanced Cardiac Morphology for 7 years. Attendees came from far and wide to attend this course, which included hands-on manipulation of cardiac specimens. His understanding of cardiac morphology and recognition of his extraordinary teaching style culminated in over 220 invited lectures around the world (Fig 11) including The World Congress of Pediatric Cardiology and Cardiac Surgery, the annual The Children's Hospital of Philadelphia Cardiology Update conference, and The Society of Thoracic Surgeons, as well as multiple visiting professorships. In recent years, with the Weinberg's move to Baltimore to be closer to family, he was a monthly lecturer at Johns Hopkins Division of Cardiology. He gave the honoured Ann Newman lecture at The Children's Hospital of Philadelphia several years ago. Sadly, he had more to do. He had been invited to give the William Rashkind lecture this year at the upcoming The Children's Hospital of Philadelphia Cardiology Update conference, and he

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Figure 11. Paul M. Weinberg, MD presented over 220 invited lectures around the world, including The World Congress of Pediatric Cardiology and Cardiac Surgery, the annual The Children's Hospital of Philadelphia Cardiology Update conference, and The Society of Thoracic Surgeons, as well as multiple visiting professorships.



Figure 12. The achievements of Paul M. Weinberg, MD in medical education were recognised with many honours and awards. In the center of this picture are lifelong colleagues Professor Meryl S. Cohen, MD (The Children's Hospital of Philadelphia [CHOP], Philadelphia, Pennsylvania, United States of America), Professor Robert H. Anderson (Emeritus Founding Editor of Cardiology in the Young, University College, London, United Kingdom) and Professor Paul Morris Weinberg, MD (The Children's Hospital of Philadelphia [CHOP], Philadelphia, Pennsylvania, United States of America).

was also completing a textbook on cardiac morphology at the time of his death.

Over his decades of service, Dr. Weinberg's achievements in medical education were recognised with many honours (Fig 12), including the following awards:

- the Blockley-Osler Teaching Award (1998) from University of Pennsylvania School of Medicine,
- the Robert Dunning Dripps Memorial Award for Excellence in Graduate Medical Education from University of Pennsylvania School of Medicine (2009),
- the Alumni Achievement Award (2004) from Jefferson Medical College,
- the Lifetime Achievement Award from the Cardiac Center at The Children's Hospital of Philadelphia (inaugural recipient, 2011),

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Figure 13. Paul M. Weinberg, MD was often accompanied by his wife Linda during his travels around the world as a lecturer, teacher, researcher, scientist, and academician.

- and the Distinguished Teaching Award (2013) from the American College of Cardiology.

In 2018, The Children's Hospital of Philadelphia Division of Cardiology named a teaching award in his honour. This award is given annually to a junior faculty member in The Children's Hospital of Philadelphia Division of Cardiology who makes an outstanding contribution to medical education.

When word spread in our community about his death, many of the fellowship classes he taught got together virtually to reminisce about his impact on their development as paediatric cardiologists and the pride he took in their achievements. His Residents and Fellows will all remember the one-on-one time spent with Dr. Weinberg during their month on the pathology rotation, cherished time which was the framework of The Children's Hospital of Philadelphia paediatric cardiology fellowship, providing an understanding of congenital heart disease that could only be achieved by hands-on specimen review with The Children's Hospital of Philadelphia's own world expert. We will remember:

- his soothing voice and calm demeanour,
- his patience when reviewing criss-cross atrioventricular valves and unusual ventricular looping,

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Figure 14. Paul M. Weinberg, MD was beloved by his hundreds of trainees. His legacy will continue to live on through these trainees and impact the field for generations to come!

- his totipotential arch figure that taught us how to understand vascular rings,
- his diagrams and catalogue of all the variations of congenital heart disease,
- his expertise in cardiac dissection,
- his profound love of teaching, and
- his thoughtful and pragmatic approach to patient care.

We will also remember his love of dancing and his ability to stay out partying later than the 30 year olds, the funny fact that Space Balls was his favourite movie, and that his favourite desserts always included chocolate. Most importantly, we will recall the love he felt for his wife Linda (Fig 13), son Joshua (predeceased 1986), daughter Sarah, and son-in law Ricky, and his three granddaughters, Julia (9), Rena (6), and Eve (3), as well as his lifelong friendships.

In 2019, Dr. Weinberg wrote for Jefferson Medical School's 50th year reunion memory book: "In the true spirit of Hippocrates, I seek to mentor the next generation as I was mentored by the last, without expectation of reward. I am forever indebted to these educators for all the knowledge they imparted to me and for the wisdom that I acquired under their tutelage." These words are a true reflection of his unassuming dedication to teaching the next generation of paediatric cardiologists. His legacy will continue to live on through these trainees (Fig 14) and impact the field for generations to come.

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