



Louis Klein Diamond



Dr. Louis Klein Diamond, a physician who helped found the field of pediatric hematology — the study and treatment of children’s blood diseases — died at his home in Los Angeles on June 14. He had just passed his 97th birthday.

Dr. Diamond trained many future leaders in pediatrics and hematology around the world, directed the American Red Cross-National Blood Program at a critical time, and established the internationally renowned Blood Grouping Laboratory in Boston. An editorial in the *New England Journal of Medicine* described his development of the exchange transfusion procedure for curing blood disorders in newborn babies as “one of the major developments in pediatrics.”

“His first loyalty was to his patients, his second loyalty was to his patients, and so was his third loyalty,” said Dr. David Nathan of Harvard Medical School.

The chain of discoveries that culminated in exchange transfusion began in 1932 at the Children’s Hospital Medical Center in Boston. In that year Dr. Diamond and his mentor, Dr. Kenneth Blackfan, recognized that what had previously been considered to be four separate diseases of newborn infants were actually different manifestations of a single syndrome, which they termed erythroblastosis fetalis. This common condition affected about one in 200 babies, killed or irreversibly damaged half of them, and accounted for 3% of deaths among newborns: about 10,000 deaths per year in the U.S. alone. Its symptoms variously included anemia, jaundice, tissue swelling, and brain damage.

Not until the early 1940’s did it emerge that the disease is caused by a pregnant mother producing antibodies that cross the placenta and damage her fetus’s red blood cells. The antibodies proved to be against the newly discovered rhesus (Rh) blood group. An Rh-negative mother whose fetus inherits the

*In tribute to their dedicated efforts to science and medicine, deceased members of the Harvard Faculty of Medicine (those at the rank of full or emeritus professor) receive a review of their life and contributions with a complete reflection, a **Memorial Minute**.*

Rh factor from an Rh-positive father is thereby sensitized to begin producing antibodies against the fetus's red blood cells. Any subsequent Rh-positive fetus of that mother may then be attacked by those antibodies. The new realization that a mother could produce antibodies against her own fetus was revolutionary.

It then became obvious that saving the infants required exchanging their blood to get rid of three harmful components: the mother's antibodies; the newborn's damaged red blood cells; and bilirubin, a chemical produced by blood cell breakdown and causing jaundice and brain damage. Of course, one could not simply drain out all of the baby's blood at once and then inject new Rh-negative blood from a donor. Instead, the exchange had to be done repeatedly in small amounts, over many days. But a newborn's blood vessels are mostly tiny, and difficult to intubate and likely to clot with the steel needles and rubber catheters available in those days.

Dr. Diamond combined two inspirations into a breakthrough. First, he got the idea of doing the transfusion via the baby's umbilical vein, which is large and remains open for days after birth. Second, he heard that a newly developed plastic tubing had just been used successfully by neurosurgeons to drain fluid from a baby's spinal cord without causing clotting. Hence Dr. Diamond asked a manufacturer to experiment with producing 2 feet of suitable tubing, just enough to catheterize the umbilical vein of one baby. In October 1946, Dr. Diamond and Dr. Fred Allen used the tubing to cure an erythroblastosis fetalis baby by exchanging its blood over the course of several days. The announcement caused great excitement in the medical world.

However, the manufacturer had actually made 200 feet of the tubing, explaining that, as long as he was making some, he might as well make more. Dr. Diamond then began traveling around the U.S. and eventually Europe, demonstrating the exchange transfusion procedure and giving away segments of the magical tubing. Mortality from erythroblastosis fetalis dropped more than 10-fold, and with further improvements it is now negligible. The exchange transfusion procedure, which was subsequently applied to newborns with blood diseases from many other causes besides the Rh factor, is credited with saving the lives of hundreds of thousands of babies.

Already as a fourth-year medical student, the then-still-Mr. Diamond had caught Dr. Blackfan's attention for his diagnosis of a child with mononucleosis, the first case recognized at the Boston Children's Hospital. Immediately upon graduation from medical school but even before completing pediatric training, Dr. Diamond set up one of the world's first research laboratories in pediatric hematology and proceeded to train other young physicians in this specialty. Cases of children with blood diseases began to be referred to him by other Boston physicians, then by physicians elsewhere in the U.S. and around the world. He eventually trained over 75 fellows, many of whom went on to become chairs of pediatric departments, deans of medical schools, and founders of their own hematology labs, and two of whom won Nobel Prizes in physiology and medicine (Dr. Carleton Gajdusek of the U.S. in 1976, and Dr. Jean Dausset of France in 1980).

In the 1940s Dr. Diamond began determining blood groups and antibody levels in pregnant mothers and their spouses, so as to be able to anticipate whether erythroblastosis fetalis was likely to emerge at birth. As Dr. Diamond and others discovered more and more blood groups, the only available technician in his small pediatric hematology lab became swamped with work. To house more technicians and to perform more blood tests on more patients, Dr. Diamond founded the Blood Grouping Laboratory (BGL) near the Boston Children's Hospital Medical Center. Today, we take blood typing of prospective parents so much for granted that any obstetrician who does not, becomes liable for a malpractice suit. However, when the BGL introduced such blood typing as a routine test during pregnancy, it was considered novel.

One unexpected by-product of Dr. Diamond's research at the BGL was his unpublished estimate of the true frequency of illegitimate births in the U.S. (revealed by a baby's carrying blood groups lacking in both the baby's mother and her husband). Another by-product was his discovery, with Harvard biologist Ernst Mayr, that blood groups are not evolutionarily neutral markers, as had previously been assumed, but that specific blood groups predispose us to, or protect us against, specific diseases.

Collaborating with Dr. Sidney Farber, in 1948, Dr. Diamond launched the modern field of cancer chemotherapy by successfully testing the folic acid antagonist aminopterin to treat children with leukemia. A related drug is still a mainstay of childhood leukemic treatment today. Among the many blood groups and diseases discovered by Dr. Diamond, three bear his name: Diamond-Blackfan syndrome (an inherited anemia), Gardner-Diamond syndrome (a disease in which young women react to their own blood cells), and Schwachman-Diamond syndrome (a type of bone marrow failure).

Dr. Diamond was born near Kishinev in the Ukraine on May 11, 1902. Brought to the U.S. by his parents at the age of 2, he grew up in New York City before moving to Boston to attend Harvard College in 1919-1923 and Harvard Medical School in 1923-1927. He remained at Harvard for most of the next 41 years, as Professor of Pediatrics and as Associate Chief of Staff at the Children's Hospital. During this time, he took leave of absence for two years (1948-1950) to serve as medical director of the American Red Cross's new National Blood Program, at a crucial time when the program needed to be transformed from an extraordinary one-shot wartime effort for the military, into an essential on-going peacetime service for all civilians. During those two years, Dr. Diamond negotiated cooperation between many initially competing blood bank programs, and he established technical procedures and high-quality standards. He traveled around the U.S. persuading physicians and the public that giving blood was harmless to donors, life-saving to recipients, and something worth doing regularly.

Upon retirement from Harvard in 1968 at the age of 66, Dr. Diamond moved to the University of California at San Francisco as adjunct Professor of Pediatrics, to set up a pediatric hematology lab there. Upon retiring from UCSF in 1987 at the age of 85, he moved to UCLA Medical School, where he remained professionally active until his 90's. In Los Angeles, he continued to follow patients with Diamond-Blackfan syndrome whom he had begun treating at their birth several decades previously.

His many awards include the Mead Johnson Award and the Apgar Award of the American Academy of Pediatrics, the Howland Award of the American Pediatric Society (of which he also served as President), and the Abraham Jacobi Award of the American Medical Association. He authored or co-authored nearly 200 papers and several texts, including the landmark *Atlas of the Blood in Children* (1944). In December 1998, his wife of 69 years Flora Kaplan Diamond died half-a-year before him. He is survived by their son Jared Diamond, their daughter Susan Diamond, and four grandchildren, all of Los Angeles.

Respectfully submitted,

Jared Diamond