



## <Citation for 2009 Japan Prize>

### Dr. David E. Kuhl (USA)

**Field Eligible for the Award:** Technological integration of medical science and engineering

**Achievement:** Contributions to the tomographic imaging in nuclear medicine

#### **Citation for the Award:**

In the late 1950s, Dr. David Kuhl developed a novel method of tomographic imaging of the distribution of radioactive isotopes in the body. A University of Pennsylvania group that he headed developed a series of SPECT (single photon emission computed tomography) devices – the Mark II in 1964, the Mark III in 1970, and the Mark IV in 1976. The group also advanced the medical use of tomographic image reconstruction based on numerical computation, and made the transaxial section tomography of a living body possible for the first time in the world. They improved tomographic image quality, and proved their clinical efficacy for image separation in brain tumors and stroke. In the mid-1960s, Dr. Kuhl succeeded in the axial transverse tomographic imaging of humans. This was well before the development of X-ray CT by Dr. Hounsfield, and the technology had an enormous impact on the development and evolution of various methods of computer tomography, including positron emission tomography (PET).

In the early 1970s, Dr. Kuhl measured regional cerebral blood volume using the reconstructed tomographic brain images of radioactive isotopes obtained by his SPECT scanner. This was the first time that physiological functions of a living body had been measured three-dimensionally. It opened a new road in nuclear medicine, from the quantitative evaluation of the regional cerebral blood flow and metabolism, which is extremely important in the field of cerebral circulation and pathophysiology, to scientific research such as neurophysiology, neuroscience, and behavioral science.

During roughly the same period, Dr. Louis Sokoloff of the National Institute of Mental Health discovered that autoradiographic imaging using the  $\beta$ -ray emitting radionuclide  $^{14}\text{C}$ -deoxyglucose was effective for evaluating regional metabolic functions in animal brain. Aiming to employ this technique clinically, Dr. Kuhl's group conducted joint research with Dr. Sokoloff and with Dr. Alfred P. Wolf of the Brookhaven National Laboratory, ultimately reaching the conclusion that  $^{18}\text{F}$ -fluorodeoxyglucose (FDG) was the most appropriate positron-emitting tracer for human use. On August 16, 1976, FDG was synthesized at Brookhaven and transported to the University of Pennsylvania, where it was used, with the SPECT Mark IV, to successfully image the metabolism of the human brain for the first time. Subsequently, FDG came to be widely used throughout the world as a radiotracer for PET imaging of the brain, the heart, and the tumors. It played a pivotal role in the spreading of PET.

At present, PET and SPECT have become indispensable in clinical medicine. Moreover, through fusion of these images with X-ray CT and MRI, their usefulness as integrated image information has been increasing as well. The radionuclide medical imaging achieved through the development of various molecular probes, which is now called molecular imaging, is expected to make great advances with the active future development in basic and clinical research.

Dr. Kuhl, who has been called the father of emission tomography, has greatly contributed to the development of tomographic imaging in nuclear medicine, and is thus deemed most eminently deserving of the 2009 Japan Prize given to honor contributions to “Technological integration of medical science and engineering.”

## <Curriculum Vitae>

### Dr. David E. Kuhl

Professor of Radiology, University of Michigan Medical School

**Nationality:** United States of America

**Date of Birth:** October 27, 1929 Age:79

#### **Academic Degrees:**

1951 B.A., (Physics), Temple University

1955 M.D., University of Pennsylvania

#### **Professional Career:**

1955-1956 Internship (Rotating), Hospital of the University of Pennsylvania

1958-1962 Radiology Fellowship, Hospital of the University of Pennsylvania

1958-1961 Assistant Instructor in Radiology, School of Medicine, University of Pennsylvania

1961-1963 Instructor in Radiology, School of Medicine, University of Pennsylvania

1963-1965 Associate in Radiology, School of Medicine, University of Pennsylvania

1965-1967 Assistant Professor of Radiology, School of Medicine, University of Pennsylvania

1967-1970 Associate Professor of Radiology, School of Medicine, University of Pennsylvania

1970-1976 Professor of Radiology, School of Medicine, University of Pennsylvania

1974-1976 Professor of Bioengineering, School of Electrical Engineering, University of Pennsylvania

1963-1976 Chief, Division of Nuclear Medicine, Department of Radiology, Hospital of the University of Pennsylvania

1975-1976 Vice Chairman, Department of Radiology, Hospital of the University of Pennsylvania

1976-1984 Chief, Division of Nuclear Medicine, Department of Radiological Sciences, University of California at Los Angeles School of Medicine

1976-1984 Associate Director, Laboratory of Biomedical and Environmental Sciences and Chief, Laboratory of Nuclear Medicine, University of California at Los Angeles

1976-1986 Professor of Radiological Sciences, University of California at Los Angeles School of Medicine

1977-1986 Vice Chairman, Department of Radiological Sciences, University of California at Los Angeles School of Medicine

1986-2000 Professor of Internal Medicine, University of Michigan Medical School

1986-2002 Chief, Division of Nuclear Medicine, Departments of Internal Medicine(1986-2000) and Radiology(2000-2002), Director, PET Center

1986-Present Professor of Radiology, University of Michigan Medical School

**Affiliation:** University Hospital  
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**Major Publications:**

1. Kuhl, DE, and Edwards, RQ: Image Separation Radioisotope Scanning. *Radiology* 80: 653-662, April 1963
2. Kuhl, DE, Hale, J, Eaton, WL: Transmission scanning: A useful adjunct to conventional emission scanning for accurately keying isotope deposition to radiographic anatomy. *Radiology* 87(2):278-84. August 1966.
3. Kuhl DE, Reivich M, Alavi A, Nyary I, Staum M. Local Cerebral Blood Volume Determined by Three-Dimensional Reconstruction of Radionuclide Scan Data. *Circ Res* 1975;36:610-9
4. Ido, T, Wan, CN, Casella, V, Fowler, JS, Wolf, AP, Reivich, M, and Kuhl, DE: Labeled 2-Deoxy-D-Glucose Analogs. 18-F-Labeled 2- Deoxy - 2 - Fluoro-D-Glucose, 2-deoxy-2-2 fluoro-D-mannose and 14 - C - 2 - deoxy - 2 - fluoro-D-glucose. *J Labeled Compounds and Radiopharmaceuticals* 14: 175-183, 1978.
5. Reivich M, Kuhl DE, Wolf A, Greenberg J, Phelps ME, Ido T, Casella V, Fowler J, Hoffman E, Alavi A, Sokoloff L. The F-18-Fluorodeoxyglucose Method for the Measurement of Local Cerebral Glucose Utilization in Man. *Circ Res* 1979;44:127-37
6. Phelps, ME, Huang, SC, Hoffman, EJ, Selin, C, Sokoloff, L, Kuhl, DE, Tomographic measurement of local cerebral glucose metabolic rate in humans with (F-18)2-fluoro-2-deoxy-D-glucose: validation of method. *Annals of Neurology*. 6(5):371-88. November 1979.
7. Kuhl DE, Engel J Jr, Phelps ME, Selin C. Epileptic Patterns of Local Cerebral Metabolism and Perfusion in Humans Determined By Emission Computed Tomography of 18FDG and 13NH3. *Ann Neurol* 1980;8:348-60
8. Minoshima, S, Foster, NL, Kuhl, DE. Posterior cingulate cortex in Alzheimer's disease. *Lancet*. 24; 344(8926):895. September 1994.

**Major Honors and Awards:**

- 1976 Nuclear Medicine Pioneer Citation, Society of Nuclear Medicine
- 1981 Ernst Jung Prize for Medicine, Jung Foundation, Hamburg
- 1985 The Louise and Lionel Berman Foundation Award for Peaceful Uses of Atomic Energy
- 1989 Elected to the Institute of Medicine of the National Academy of Sciences
- 1989 Javits Neuroscience Investigator Award, National Institutes of Health
- 1995 Georg Charles de Hevesy Nuclear Medicine Pioneer Award, Society of Nuclear Medicine
- 1996 Benedict Cassen Prize for Research Leading to a Major Advance in Nuclear Medicine Science, Society of Nuclear Medicine
- 1996 Outstanding Researcher Award, Radiological Society of North America
- 2001 Charles F. Kettering Prize for Outstanding Contribution to the Diagnosis and Treatment of Cancer, General Motors Cancer Research Foundation

**Member:**

1. American College of Nuclear Physicians
2. American College of Radiology
3. American Institute of Medical and Biological Engineering
4. American Neurological Association
5. Association of American Physicians
6. Institute of Medicine of the National Academy of Science
7. Radiological Society of North America
8. Society of Nuclear Medicine

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