In memoriam

Homer Richards Warner, 1922–2012

Warner’s and his associates’ research that gave rise to ILIAD and ODYSSEY “began when the medical staff identified several educational problems”: (1) students failed to read medical literature and they were “frustrated by the convoluted language structures one must learn to search online-databases unassisted, (2) students clerg in the third year had poor decision making skills” and (3) “the patient care area is remote from the library. To promote maximum learning efficiency, patient care experiences must be immediately reinforced with reading and reflection. But students must extricate themselves from the wards and travel to a storehouse of knowledge, the library.” ([5], p. 488). There were already computer programs to resolve this grievance. Chin-Li Fan, then a master student of Warner, mentioned in his thesis William J. Clancey’s CAI program GUIDON ([3], p. 4f) that was developed for teaching infectious disease diagnosis using the knowledge base of Edward Shortliffe’s expert system MYCIN at Stanford University already in the early 1970s [6]. In their conference publication on ODYSSEY in 1987 Fan, Warner and their co-authors mentioned also QMR (quick medical reference) [7] and HELP (health evaluation through logical processing) [8]. The former was developed by Randolph A. Miller at the University of Pittsburgh in 1980, based upon the INTERNIST-I patient diagnosis system by Jack D. Myers, Miller and Harry E. Pople [9]; the latter was created by Warner and his team, and we will come back to this part of the story very soon, but we want to maintain that these systems succeeded – “in part” – as they wrote: “A student can enter a patient’s findings and produce a list of possible diagnoses. But neither program permits students to enter a disease or pathophysiologic concept and access information about that disease or concept. Students who wish to do this must manually search multiple knowledge bases, including the medical literature and textbooks. It is often impossible to do this in a timely, relevant, and efficient manner.” ([10], p. 488). ODYSSEY was designed to resolve this issue; it was a database manager to facilitate student access to several medical knowledge bases. The program was written in Aztec C and it run on a Macintosh Plus computer system.

However, as Warner and his co-authors wrote in 1987, ODYSSEY was “part of a larger effort at the University of Utah School of Medicine to augment student learning” ([10], p. 491) and other parts were the already mentioned ILIAD and HELP.

ILIAD is “a micro-computer-based system that can mimic an expert diagnostician” to teach medical students during their third year clerkship on internal medicine about differential diagnosis. ILIAD is “able to recognize each of the diseases”. Warner and his associates expected “a medical student to become familiar with”. This program system provides the students with immediate expert consultation at any stage and gives advice to “the student on the most appropriate observation to make next.” ILIAD emanated from the HELP system developed by Homer Warner at the Latter-Day Saints (LDS) Hospital in Salt Lake City, Utah and also ODYSSEY


Homer, the ancient Greek poet (8th or 7th century BC) was the creator of the iliad, an epic poem of dactylic hexameters that tells us the history of the Trojan, and also – as a kind of sequel – the Odyssey that tells us about the hero Odysseus’ journey home after the fall of Troy in dactylic hexameters.

Homer Richards Warner (1922–2012), the US-American cardiologist was the creator of ILIAD and ODYSSEY in the 20th century, two computer systems to support teaching and learning during the medical internship at the University of Utah.

Computers have been used as aids for teaching in direct interaction with students since the 1960s and the National Science Foundation (NFS) sponsored two large scale projects to introduce computer-assisted instruction (CAI) into schools at the end of this decade: PLATO (program logic for automatic teaching operations) and TICCIT (time-shared interactive computer-controlled information television) [1–4]. PLATO provided about 1000 terminals with a centrally stored library of lessons not only on medicine but also on chemistry, computer sciences, and language. TICCIT combined two mini-computers and television receivers in an instructional system for up to 128 terminals.

When NFS commissioned the Educational Testing Service (ETS) to evaluate the potential of the computer in college teaching, and even the test results “showed that computer-based instruction made small but significant contributions to the course achievement of college students and also produced positive, but again small, effects on the attitudes of students toward instruction and toward the subject matter they were studying” ([5], p. 525), there was also the view that “institutions of higher education would accept computer-assisted instruction as an additional resource for promoting student learning.” ([3], p. 3).
included a literature reference database and the HELP system’s collection of decision-making frames. Incipiently, HELP is operational since 1967, the program supported a heart catheterization laboratory and a post open heart intensive care unit (ICU) but meanwhile it has been expanded to become an integrated hospital information system “providing services with sophisticated clinical decision-support capabilities to a wide variety of clinical areas such as laboratory, nurse charting, radiology, pharmacy, etc.” ([111], p. 169). Following this path features a tour d’horizon of the history of medical informatics that was intertwined with Warner’s life.

As a son of Homer (Pug) and Grace Richards Warner, Homer Richards Warner was born April 18, 1922. His father was a star receiver on the “U” (University of Utah) football team and Homer junior, who played already football for East High School, also enrolled at the university in Salt Lake City where he played the quarterback. “Playing football at the University of Utah was more interesting than his pre-med studies, so he was turned down when he applied for admission to the Medical School” he wrote about himself in a third-person narrative ([12], p. 474). Due to this rejection he volunteered for the Navy in World War II. He was trained as a carrier-based fighter pilot and served two years in the Navy before the war ended, but he saw no combat. He returned to the university where he met Katherine Ann Romney and they graduated together in 1946 and later married in the Salt Lake Temple of the Church of Jesus Christ of Latter Day Saints, as Mormons are formally known. Homer’s great-grandfather Willard Richards was one of the original Mormon settlers who trekked westwards from Nebraska to Utah to avoid religious persecutions. Later, Homer himself served as a bishop of the Colonial Hills First Ward and – together with his late wife Katherine – as medical missionaries in Europe in 1966/1997.

Homer R. Warner graduated with a bachelor’s degree in Zoology and applied under an accelerated wartime program to medical school again. This time he was accepted and he finished three years later in 1949. He continued with an internship at the University of Texas in Dallas Parkland Memorial Hospital with the influential physician Tinsley Harrison who had special interest in cardiovascular medicine. In the next year Harrison sent Warner as a resident to hematologist and pathologist Cecil Watson at the University of Minnesota and during that time Warner also worked at the Mayo Clinic in Rochester, Minnesota, where he became stimulated by physiologist and cardiologist Earl H. Wood (1913–2009) to develop interest in medical research. He applied for a year in physiology to work with Wood’s group, began his studies in cardiovascular physiology and finished the residency at this place. “During these very early days of heart catheterization and diagnostic physiological testing, Mayo Clinic researchers were injecting a blue dye into people, mostly children, with different kinds of right-to-left and left-to-right shunts, trying to detect and quantitate the degree of shunt from the shape of the indicator dilution curve recorded downstream” Warner recalled ([12], p. 475). Wood spurred Warner’s interest in the development of “a method for estimation stroke volume from the shape of aortic pressure waves” that led to a publication by Warner, Wood, H.J.C. Swan, D.C. Connolly and R.C. Tompkins [12]. This “performed so well that Wood suggested Warner’s research work could become a doctoral dissertation” ([13], p. 475f). In this thesis which was entitled “The Central Arterial Pressure Pulse Contour as an Index to Left Ventricular Stroke Volume” [14], Warner had to manage “mathematical techniques to parameterize the shape and area under the arterial pressure waveform to predict cardiac output” ([15], p. 138). Warner spent one year with Maurice Vissher, the head of the Department of Physiology at the University of Minnesota, to complete his studies in mathematics and engineering and to conform to all formalities for his PhD in Physiology that he earned in 1953. In the same year he went back to the U and with a one-year American Heart research fellowship he supported the chief of the section of cardiology that was formed in 1950, to establish the first modern heart catheterization laboratory in the western United States. Not even a year later he switched to the LDS Hospital, after Salt Lake’s heart surgeon William Ray Rumel and Clarence Wonacott, the administrator of the LDS Hospital, offered him the chance to open the state’s second Cardiovascular Laboratory and from July of 1954 Warner was to work there for the next thirty-two years.

“Dr. Homer Warner with his first computer in the LDS Hospital Cardiovascular Laboratory, Salt Lake City, Utah. (Photo: courtesy of Intermountain Healthcare).”

“At first, most of the cases were patients with congenital heart disease, since surgery for the lesions was new and many accumulated patients were potential candidates for treatment” Warner recalled in 1995 ([13], p. 476). To set up the lab Warner had received a budget of $10,000 to buy equipment, but in 1955, when the hospital got a $220,000 Ford Foundation grant, the lab was supported to start with Warner’s research on a phenomenon that interested Warner already in his PhD thesis work, i.e., “a study of the way a pressure wave is distorted as it travels from the root of the aorta out to the periphery” ([13], p. 477).

To acquire the necessary mathematical knowledge he took an engineering math course at U where he was taught the concepts of Fourier analysis (representing a wave form as a combination of sine waves of different frequencies) and transfer functions (describing the input-output relation for a linear system) and during the nights he started to perform with these concepts the Fourier analysis and transfer function analysis of heart beats. He analyzed a “pressure wave recorded from a catheter in the radial artery of a patient” and “looking first at the harmonic content of the upstream pressure wave form, recorded through a catheter up in the root of the aorta, and then at the wave form recorded down at the radial artery. The harmonics of the two wave forms had different amplitudes. The plot looked very similar to the transfer function of the tuned circuit the instructor had used in his illustration” ([13], p. 477). With the mathematical model Warner aimed to calculate the patient’s heart’s pumping capacity and with help of U’s electrical engineer Dietrich Karl Gehmlich he constructed resistor, capacitor and inductor to build a tunable circuit that served as an analog computer that could crudely calculate these tasks.

Now he was able to demonstrate for the first time in experiments on animals (dogs exercising on a treadmill) that the amount of blood pumped by the heart during exercise was dependent upon the dilation of the blood vessels in the exercising muscles. His first article about a computer to analyze waveforms appeared in 1959 [16] and in May 1960 when they had collected the data of eighty patients – it was the first time that measurements of the distensibility and the frictional resistance of the artery, and the inertia of the
blood column using catheters in the aorta and radial artery had been made directly in living persons – Warner and Alan Lusted published the results of their “analog computer-supported diagnostic studies” [17].

When the University of Utah installed a digital computer in 1960 Warner and his coworkers switched to the new tool that was available to them after nine o’clock pm. They studied “the way the concentration curve following a sudden dye injection is recorded at various points downstream. The transfer function of the upstream and downstream curves becomes a measure of the distribution of transit times of blood particles as they travel between recording sites. For example, transit time through the kidneys is very rapid, something less than ten seconds. However, for blood flow through the legs and back to the heart may take as long as several minutes” Warner recalled ([13], p. 479).

In that time Warner worked for these research studies with graduate students. Thus, L. George Veasy became co-author of the next publication [18] and also Robert Stephenson who was the director of U’s computer center became dean of the School of Engineering in 1960. Stephenson showed Warner the seminal Science-article “Reasoning Foundations in Medical Diagnosis” by Robert S. Ledley and Lee B. Lusted, published in 1959 [19]. This “frequently cited as the most influential early paper to propose the use of computers as diagnostic assistance” ([22], p. 209) mapped a research program for the next 15 years, as investigators spun out the consequences” that “medical reasoning was not magic but instead contained well-recognized inference strategies: Boolean logic, symbolic inference, and Bayesian probability. In particular, diagnostic reasoning could be formulated using all three of these techniques.” ([23], p. 68).

One section in Ledley’s and Lusted’s article gave “an introduction to Bayesian statistics and pointed out the relevance of Bayes’ rule to the problem of medical diagnosis” ([22], p. 209). Warner and Stephenson agreed to realize this proposition to use probability theory to model the medical diagnostic process and to apply this idea to congenital heart disease using the digital computer and they proved that it could diagnose as well or even better than cardiologists.

More than 30 years later Warner explained in his third-person narrative: “To aid the patients coming through Warner’s laboratory, they decided to make their model to diagnose thirty-five different forms of congenital heart disease. First, they collected data on how frequently each of fifty different findings, such as murmurs of different kinds and cyanosis, occurred in each disease and how common each disease was in the population of patients referred to the laboratory. After collecting several hundred such cases, a matrix showed the disease on one axis, the findings on the other. At each intersection of the symptom with the disease, a number represented the frequency of that finding in patients with that disease. This table formed the basis for the diagnosing patients based on findings recorded by their referring physicians. A comparison of the computer diagnoses and those of the referring physicians showed the computer to be right more often than any of the physicians, based on diagnosis following heart catheterization.” ([13], p. 479f).

They presented their findings at an American Heart Association meeting and their article appeared in 1961 in The Journal of the American Medical Association (JAMA). This article was “among the most frequently cited” papers to “determine whether Bayesian techniques could be effectively applied to diagnostic problems” wrote E. H. Shortliffe in 1988 and “the first published example of automatic diagnosis using real patient data and comparing computer-derived results with human diagnostic abilities” wrote former student of Warner, then chair of Medical Informatics at Columbia University, Paul D. Clayton in 1995 ([22], p. 209; [15], p. 139). The article became one of the most important and crucial papers in the history of medical decision making. Among other figures Beck, Pyle, and Lusted showed in their “Citation Analysis of the Field of Medical Decision Making”, published by in 1984, a tree of 61 journal articles on this topic in the period 1959–1978. The arcs “represent direct citation in later work of earlier paper in the tree” ([24], p. 460). Paper “L59”, viz. Ledley’s and Lusted’s article [19] is the root and directed from that there are arcs directed for either papers “W61”, viz. [18], “S63” [25], and “D72” [26]. The figure makes clear that “the bulk of articles in the field of medical decision making cited Homer’s 1961 JAMA article” [18] wrote Clayton concerning this figure ([15], p. 139).

In the end Warner received an NIH grant (National Institutes of Health) of about $500,000 per year for a digital computer in the LDS Hospital laboratory. They bought the CDC 3200 machine that was newly released from Control Data Corporation in May 1964 and in 1965 Warner and Thomas Allan Pryor (1937–2009), who had obtained an MS degree in mathematics at the U and acquired comprehensive computer knowledge from a job at NASA, wrote their own time-sharing operating system [27]. The program that Pryor wrote for his PhD dissertation provided automated interpretation of the ECG; it was used by the LDS Hospital until it was replaced by a commercial system in 1985. At the beginning the LDS cardiologists “could always find fault with” this program system, but then cardiologist Alan E. Lindsay (1923–1987) agreed to provide the team with electrocardiographic expertise. In the end Lindsay felt it was at least in part his program “Warner recalled. “Then Lindsay went to his colleagues in cardiology, showed them the facts, and convinced them that the program was doing a more consistent job of interpreting the electrocardiograms (ECGs) than they were. The department learned that to get this new technology accepted by users they must first convince someone respected in the field and then let that person sell it to his or her colleagues.” ([13], p. 484).

Warner’s research ideas to develop new computer applications (automated monitoring programs, ECG interpretation, etc.) attracted many students. One of them was Reed MacArthur Gardner (born 1937), who was then an electrical engineer with Hewlett Packard (HP). Stephenson encouraged him to meet Warner, and Gardner was very impressed by seeing the large computer processing real patient data in the clinical setting. He joined Warner’s team as one of his first PhD candidates and he worked with him for the next four decades. Warner commemorated in 2006: “His PhD thesis was concerned with the measurement of

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1 For information on this article and these authors see [20,21].

2 Warner was quoted by Joseph W. Hales in the “Presentation of the Morris F. Collen Award to Reed MacArthur Gardner, PhD” [28].
changes in aortic diameter of the descending thoracic aorta from an angi cardiogram. He developed a method, basically a track-and-hold-circuit, that would allow him to make these diameter measurements 100 times a second. We could then look at the effect of pressure-volume relationships in the aorta for the first time – a very exciting period for us. We used loops and analog tape recorded to play over and over again these angiograms and Reed then did an analysis of these angiograms in a variety of physiologi cal states.” ([29], p. 357). In addition to the already named members of Warner’s team there came electrical engineer John D. Morgan, physician Marion Dickman, physicist Justin Clark and physician Hiram W. Marshall, population geneticist Mark Skolnick, physi cian and computer expert Peter Haug, radiologist Phil Frederick and pathologist Stan Huff.

Almost coincidental with the beginning phase of the LDS Cardiovascular Catherization Lab (CV cath lab) Warner also started teaching in the faculty of Physiology at U. Because he was also affiliated with the school of engineering, he presented his computer-supported medical research work since 1955 to gradu ate students in physical chemistry and several of them came to do research for their doctoral theses under Warner’s supervision at LDS. Thereupon Graduate School’s Dean Henry Eyring enforced the establishment of a new Department of Biophysics and Bioengineering at U. Because “the medical faculty felt the time was not right for such a move, but Dean [Max] Williams said the engineering facul ty would become a bioengineering department since there were many areas of possible joint interest for both research and teaching. So the Department of Biophysics and Bioengineering was established, with laboratories at LDS Hospital and Merrill Engineering” ([Building] of the U in 1964 with Homer Warner as chair ([113], p. 483). Warner kept this position for 32 years and in 1996 Reed M. Gardner assumed this position until 2005.

When the department was split into the Department of Bioengineering in the School of Engineering and the Department of Medical Biophysics and Computing in the School of Medicine in 1972, Warner became director of the latter.

The new department in the 1960s and the striking success of Warner’s research became the starting phase of a new academic base: the first graduate of the new program was the electrical engi neer Stanford Topham in 1967 and “since then, the department has granted an additional 150 degrees to graduate students of medical informatics” ([115], p. 139). About 30 years later it was the second largest graduate training program in the medical school for master’s and PhD degrees ([113], p. 484) and at the very end of the last century Gregory A. Patton and Gardner could report that “over the 35 years since the program’s inception, 272 graduate students have studied in the department” and “a total of 209 graduate degrees have been awarded” ([27], p. 457). Doctor of Philosophy degrees awarded were initially in medical biophysics and computing and more recently in medical informatics. A Master of Science in Medical Informatics degree has been awarded since 1976.

In March 1967 Warner founded the journal Computers and Biomedical Research and he was the editor in chief until the issue 6 of vol. 26 was published in December 1993. Then his former student T. Allan Pryor, then Professor of Medical Informatics at U, assumed this role. Warner’s first article about computer-assisted learning, published with Alberto Budkin (born 1938), appeared in his new journal in October 1968 [30].

Around 1970 “many of the group’s cath lab programs moved to the operating rooms. […] Most of these patients were moved immediately to an ICU, so it was quite natural that the next phase of this research was designed to continue the monitoring there. The group developed a special console for the ten-bed post-open heart-surgery unit. The console at the nursing station had a bank of lights – a red, a yellow, and a green light for each patient. The green light indicated that the computer was actively sampling data from a patient. At regular intervals the program would display the data being sampled – a pressure or an ECG waveform. The yellow light indicated that something had happened to that patient’s data; that there was an abnormal trend in some variable. Maybe the pressure was dropping or the cardiac output was going down or the peripheral resistance was rising. The computer calculated each of these variables automatically from the shape of the aortic pressure waveform measured through a small arterial catheter introduced by a nurse the night before surgery. The red light indicated an emergency that required immediate action. The yellow and the red lights were also interrupt buttons that would make the computer display a graph of the time course of the variable that was out-tending in the wrong direction.” ([113], p. 481).

In these years Warner was intended to establish a teaching sys tem that was based on real patient data and uses mathematical and statistical models to simulate “cases” that require decision-making by the learning student. In his memories Warner has pegged a spec ific event as a light bulb moment in the pre-history of that system: some day when he visited the ICU and he “saw a nurse pumping up a blood pressure cuff on the left arm of a patient who had a pressure-monitoring catheter in the right arm. A yellow light showed on the panel. The nurse was embarrassed when she saw him watching her and explained that she didn’t know what to do next. They sat down at the computer terminal and looked what all the data in both the computer and the chart. They called the resident and jointly decided that the patient probably was having a cardiac tamponade. The surgeon on call promptly took the patient back to the operating room. This experience became another important turning point in Warner’s approach to the application of computers in medicine” Warner recalled ([113], p. 482). Obviously this ICU nurse was overwhelmed by that massive information from various sensors and it was clear that she needed guidance that he could offer in that situation, but Warner also started thinking on the option that the computer itself could help to avoid such a difficult situation. In the solution he pursued the computer itself should provide interpreta tion of the data “and that interpretation required more data than just the hemodynamic measurements. It required data from other sources, such as chemistry and hematology labs and X-ray interpretations, but most of all it required that the computer have some medical knowledge. They needed to build intelligence into the system.” ([113], p. 482). This “next generation” system came in the 1970s and initially it was given the moniker HELP because it was planned to help physicians as an automated second opinion; in later years this name became the acronym for “Health Evaluation through Logical Processing”.

Dr. Homer R. Warner, T. Alan Pryor, and Reed M. Gardner with Control Data 3300 at LDS Hospital in the data center of the early HELP System, about 1975 (Photo: courtesy of Intermountain Healthcare).
HELP evolved as a composition of various developments: The conceptualization came from Warner who wrote the first draft of this program in a hotel at Lake Geneva between two European meetings where he had to present papers ten days apart. The concept used already running systems that have been created with Reed's hardware and Pryor's software: “the important data collected and used in HELP were largely gathered from bioinstrumentation built or integrated by Reed. Over time, Reed contributed to hardware for bedside blood pressure monitoring, pulmonary function testing, and monitoring and charting of mothers during delivery.” ([28], p. 357). Pryor built HELP’s architecture and his time-sharing system solved the allocation and priority problems for the system’s multiple users. “The next step was to put some flesh on the skeleton – to put medical knowledge into the shell program that the computer could execute. Two young physicians, Charles Olminstead and Barry Rutherford, were working with Warner, and together they developed a knowledge base of rules and relationships for management of patients in the ICU and for interpretation of measurements made in the cath lab.” ([13], p. 482, see [31,32]).

HELP was developed on the CDC 3200 machine at LDS hospital. It became the first computer-based patient record system and it expanded during the next years. After 18 years the hardware was out of date and parts could not be replaced any longer but NIH did not fund a new computer. Eventually LDS Hospital bought a new machine and supported the reprogramming – and owned the HELP system whereas Control Data Corporation (CDC) assumed the marketing of the renewed system until 1987 when it was sold to the 3M company.

In 1977 while on sabbatical in Vancouver, B.C., Homer R. Warner authored the medical informatics textbook Computer-assisted medical decision-making [33] on his sailboat.

In the 1980 many medical researchers moved from the Department of Bioengineering in the Engineering School to the Medical School and in 1985 when Warner’s Department of Medical Biophysics and Computing was formally renamed the Department of Medical Informatics, also Warner moved after 30 years at LDS Hospital to the University of Utah’s Medical Center.

The Medical School “perceived the task of getting HELP running at the University Hospital as integrally linked to the long-range future of the department and involving primarily political challenges” ([13], p. 487). A TANDEM computer was planned to be purchased to run the HELP program and to develop applications for the needs of the clinicians. “But Warner was not given access to the HELP system at the University because the “pure vanilla” version provided by Control Data Corporation was not allowed to be changed at all, and none of its clinical or decision-making features had been implemented as of this writing in mid-1991” Warner recalled ([13], p. 487).

With support from a National Library of Medicine grant and the help of clinicians from the Department of Internal Medicine Warner’s team developed the new expert system ILIAD for automated diagnosis, designed as a teaching and consulting tool with a knowledge base representing more than 500 diseases.

In 1995 Warner could report that ILIAD was in use to teach diagnostic skills to medical students at the University of Utah's and more than thirty other medical schools. Also HELP is still operational in multiple hospitals of LDS Hospital’s parent health care enterprise – the nonprofit health system based in Salt Lake City, Intermountain Health Care (IHC).

In 1994 – he was 72 years old – Warner became the Medical center’s “chief information officer” and in 1996 he retired from this position. We saw already that then he and his late wife Kay (Katherine Anne Romney) traveled as medical missionaries in Europe. Kay died in 2007; the couple six children, 23 grandchildren and 39 great-grandchildren. In 2009 Homer Warner married Kay’s lifelong friend Jeannie Okland (whose husband, Jack, had also died). After Jeannie passed away in 2011, Warner married June Okland Cockrell (Jack Okland’s sister).

At February 16, 2011 at Intermountain Healthcare officially opened the Homer Warner Center for Informatics Research on the campus of Intermountain Medical Center in Salt Lake City to support its clinical information systems. At December 6, 2012 the American Medical Informatics Association granted the Homer R. Warner New Investigator Award annually, in his honor. He had died from complications of pancreatitis, seven days before, November 30, 2012.

Obituaries said that he was “the man who brought computers into medicine” [34] or “the father of medical informatics” [35,36], and one of its founders [36]. So it is worth to face his definition of “Medical Informatics” as “the study, invention, and implementation of structures and algorithms to improve communication, understanding, and management of medical information” ([37], p. 207). It is from the starting sentence of his American College of Medical Informatics (ACMI) Distinguished Lecture “Medical Informatics: A Real Discipline?” at the American Association for Medical Systems and Informatics (AAMSI) 1988 Congress in San Francisco, CA.

In this lecture, Warner emphasized that “Knowledge engineering is evolving as a new profession within medical informatics. The challenge is to capture the expertise of someone who performs an intellectual task well in the form of a model that can be executed by a computer system” and he continued with the identification of what skills a knowledge engineer must have: quick learning, good communicating excellence, team leading, organizing, and psychological capabilities ([37], p. 210).

Later in this talk, he offered questions for further discussion: “Is medical informatics like mathematics? Does it take years of study, one course building on the other, to get to a position to make a contribution to our field or to make a career in medical informatics? How about psychology? I believe informatics is
a behavioral science. Does information exist outside the context of human thought? Everyone considers himself or herself a psychologist up to a point. Is our discipline intuitive that formal training is not necessary? Then there is computer science. Are our graduates able to compete as programmers with computer science graduates? No, I don’t think so. In fact, it will become less so in the future as our tools become better. We will need people who are knowledge engineers rather than computer scientists.^[3]\(^{[38]}\) ([37], p. 213).

In 1984 Warner became Elected Fellow of the ACM and he was its President from 1988 to 1990. He was elected to senior membership in the Institute of Medicine of the National Academy of Sciences in 1988 and in 1995 he was recipient of the Morris L. Collen of the ACM in recognition of his lifetime contributions to the discipline. The Object Management Group (OMG) created the Homer R. Warner award that is presented each year at AMIA.

An almost 1 h interview with Homer R. Warner was part of the Dean’s Roundtable series (Dr. Vivian S. Lee, Dean of the School of Medicine, University of Utah Health Care) in November 2012, shortly before he passed away, and can be found here: http://healthsciences.utah.edu/notest/postings/november_2012/113012HomerWarner.php.

References

[^3]: For further information on this concept of knowledge engineering in medical informatics see [38].