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From death defying to death defining

Author
Giacomini, Mita K.

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From Death Defying to Death Defining:

Technological Imperatives and the Definition of Brain Death in 1968

by

Mita K. Giacomini

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Table of Contents

...we shall be convinced, that between life and death the shade is so very undistinguishable, that even all the powers of art can scarcely determine where the one ends and the other begins.

Encyclopedia Brittanica, 1797

...legally, I suppose, a man is dead when he has undergone irreversible changes of a type that make it impossible for him to seek to litigate.

Peter Brian Medawar, 1946[1]

I. Introduction

In 1968, an *ad hoc* committee of Harvard University faculty redefined death as "brain death." It declared a nonfunctioning brain the fundamental medical sign of death, supplanting the traditional criteria of ceased heartbeat and respiration. Because the brain can "die" well before the heart stops beating, the brain-based criterion would transform an entire class of intensive care patients into corpses. Among other things, these corpses would become an indispensable source of unspoiled kidneys for transplantation. The new definition of death would also justify removal of beating hearts from heart transplant donors and recipients alike without technically killing these patients.

Harvard's statement is widely acknowledges as the seminal formulation of the concept of brain death, as evident for example in the statement:

> Death concerns all of us and is a subject of interest as old as humankind. It is, therefore, surprising that a whole new look at death should have been initiated less than 20 years ago with publication of a report from the Ad Hoc Committee of the Harvard Medical School.[2]

In recent years, interest in brain death has proliferated in the medical humanities. Proponents have critiqued and refined Harvard's and subsequent criteria, to hone definitions more appropriate to contemporary needs. Typically, the Harvard criteria have been criticized for being too conservative, or "insensitive," in epidemiological terms - they do not capture everyone who is for all practical intents and purposes *dead.* Many physicians, health policy experts, and ethicists argue for expanding brain death criteria to encompass *more* medically hopeless, artificially sustained persons. Such proposals often revisit the spirit of the Harvard policy, to update the formulation while respecting its importance as precedent.

However, the Harvard Committee redefinition of death did not generate spontaneously in 1968, and the obscurity of its genesis serves to hide much of the true spirit in which brain death was defined. First, Harvard's analysis did not precede clinical applications of the concept of brain death. At least a few physicians involved in transplantation and electroencephalographic (EEG) research had for several years already been diagnosing potential organ donors as dead according to brain based criteria. Second, the Harvard criteria did not emerge in an academic vacuum. Although the sole citation in the paper is to a 1957 statement by the Pope on the artificial prolongation of life, the issues and conceptual elements of brain death had already been introduced in professional forums such as journals, books, and conferences. The Committee disassociated its origin from these academic controversies around brain death and organ procurement. Instead, the Harvard committee deliberately constructed the historical role of its statement as original and progressive.

Several varying historical explanations have arisen to account for the Harvard Committee's redefinition of death. The historical controversies surrounding brain death have been shaped by the particular purposes of those involved. For example, conventional histories of brain death have been written mostly on the occasion of introducing arguments for further modifications of the definition of death; the Harvard Committee itself established this practice in 1968. It has been carried on by others endeavoring to broaden either the acceptance of brain death as defined, or to broaden death criteria themselves to encompass a wider range of syndromes.

The most popularized historical perspective characterizes the concept of brain death as the inevitable juncture of several paths of technological development - the electroencephalograph, mechanical life support systems, and possibly organ transplantation. For instance, the following excerpt from the contemporary *Encyclopedia Brittanica* portrays brain death as a necessary byproduct of modern life support technology:

> The development in the idea and diagnosis of brain-stem death came as a response to a conceptual challenge. Intensive-care technology had saved many lives, but it had also created many brain-dead patients. To grasp the implications of this situation, society in general - and the medical profession in particular - was forced to rethink accepted notions about death itself.[3]

The author advocates redefining brain death as brain *stem* death, or the cessation of lower brain functions, and positions this argument upon a history of brain death which omits the influence of organ transplantation. This historiographic approach implies that brain death definition has not involved opportunistic motives such as transplanting fresher or more vital organs. Rather, the redefinition is simply a progressive recognition and description of contemporary dead bodies, who are unfortunate natural side effects of medical technological progress. The author treats life support technology uncritically as given, simply an environmental demand requiring social accommodation. Brain death is characterized here as a purely physical phenomenon, the proverbial "unanticipated consequence" of advances in therapeutics.

A related perspective locates the technological imperative not in therapeutic progress creating a new kind of corpse, but rather in diagnostic progress allowing enlightened scientific understanding of the very meaning of brain activity. A history of brain death written by neurologist and EEG specialist Julius Korein emphasizes that, "[c]urrent [brain death] criteria are based on available technology, knowledge, and concepts of brain function," and attributes controversy surrounding brain death criteria in part to "...the frequent confounding of brain death with other issues that are tangentially related...which include problems relating to vegetative states, organ transplantation, the rights of the individual, and decision-making relating to these issues..."[4]

In response to these "autonomous technology" or "scientific progress" accounts, Martin Pernick in a rigorous analysis argues that neither the technological impetus of the late 1960s nor the uncertainty of death diagnosis were new in the history of medicine by the moment death was redefined in 1968. Rather, "...virtually all of the technical discoveries and social developments that seemed to overwhelm our concept of death in 1967 were already known or clearly predicted between 1910 and the 1950s."[5] "Technology," from his perspective, has on many occasions over the past century blurred the boundaries between life and death; even the clinical syndrome we now call brain death has been recognized in the medical literature since at least 1898. Pernick characterizes the controversial 1968 definition of death instead as a symptom of growing distrust of the medical profession. This particular history appears as a chapter of a book exploring a more liberal definition of brain death as the cessation of higher (cerebral) brain functions alone. Pernick sets the historical stage for a new definition by demonstrating that the redefinition of death in response to medical advances and uncertainties has been endemic in modern medical history, and thus the ritual of redefinition is paradoxically more traditional than any specific death criteria themselves.

David Rothman has recently provided another alternative history which also shows how changes in medical culture, particularly response to growing public skepticism about medical autonomy, supported the redefinition of death. His account regards Harvard's interdisciplinary redefinition of death as part of a larger trend of increasing public scrutiny of medicine.[6] Rothman casts the Harvard Committee as one of the organizational milestones heralding the establishment of the sentinel profession of medical ethics; the definition of death by committee was one of medicine's incremental losses of professional autonomy to law, ethics, and the public. This particular story of brain death appears as part of a larger historical explanation of the ascendance of medical ethics, and most explicitly portrays heart transplantation as the political catalyst for the redefinition of death. Before heart transplantation, many factors, especially scandalous experimentation and the distancing effects of high technology, had already alienated patients from physicians who had become suspicious "strangers at the bedside." In 1967, the new possibility of harvesting organs from the most vulnerable inpatients drew unprecedented lay activism into the redefinition of death: "In effect, heart transplantation helped to equate the physician with the research and the patient with the subject. No one - neither the doctor nor patient - could be confident that the patient's best interest would be the sole or even central concern."[7] Here, heart transplantation instigated the transformation of death, albeit within a complex field of related technologies and cultural attitudes. The redefinition of death by committee struck a blow to medical privilege: "In the end, the Harvard report did not so much resolve the questions around brain death as propel them into the public domain."[8]

This thesis offers an alternative account of the factors leading to the redefinition of death. Two assumptions will be challenged in this analysis of how new death criteria were selected and promoted: that "technological change" itself created the bodies and the defining features of the brain dead, and that Harvard's definition of brain death by committee constituted a net loss of medical authority. First, the conventional view (and to a much lesser extent, Pernick's) overgeneralizes the historical function of "technology" as a monolithic entity, and minimizes the unique influence of specific technological interests, especially kidney and heart transplantation. The various technological "advances" involved in the redefinition of death were not equivalent in their influence. The influence was also strategic and reciprocal: the redefinition of death also promoted the "advance" of medical technology .

The popular perception of a technological imperative in the evolution of death criteria oversimplifies the relations within and between three categories: technology, cultural issues, and bodies. Conventional histories of brain death suggest that technological breakthroughs, social demands for quality care in life and dying, and a host of comatose bodies each coincidentally formed a crisis in the late 1960s which demanded a new definition of death. Controversy arose simply from the unfamiliarity of unprecedented technological effects. This technological imperative will be examined critically. The salient "technology" involved a system of emerging medical technologies such as life support, the electroencephalograph, and organ transplantation, as well as technologies less commonly credited for their contribution to brain death, such as anesthesia, open heart surgery, and the artificial heart. The strategic development of the individual technologies *and* the system they formed together contributed to an ethos which supported the redefinition of death. Pertinent "cultural issues" included popular and professional attitudes towards dying, death, medical "progress" and the legitimation of medical research, and resource allocation. Finally, brain dead bodies had to be sought, recognized, described, and defined in the development of brain death criteria. These bodies did not occupy a single cultural role. Rather, they were assigned to various problematically overlapping, socially constructed categories: organ donors, organ recipients, the hopelessly comatose, the living, the dead, customers, and consumers.

The history of the concept of brain death is above all a story of how the conflicted negotiations between technological interests and cultural traditions drew and redrew the boundaries between these bodies in the evolution of 1960s medicine. The Harvard Committee did not produce a more accurate description of death, but rather, marked new delineations between the living and the dead, and between legitimate health care customers and wasteful resource consumers. The rule which guided this dividing line was that between a hypothetical heart donor and the transplant recipient. This demarcation was driven substantially by medicine's desire to more legitimately produce the new commodities of the transplantable heart and the "fresher" kidney.

Second, Rothman interprets the Harvard Committee's work as a politically defensive act which ultimately failed either to preempt lay involvement in clinical decisionmaking or to promote acceptance of brain death. From a contemporary vantage, this is true as far as it goes: ethics committees have become an institutionalized attempt at the oversight of medical research, and there remains substantial informal resistance to the diagnosis of brain death and "harvesting" of vital organs. The concept of brain death itself has been tinkered with ceaselessly over the past two decades by physicians and philosophers alike.

From another angle, however, definition of brain death was a negotiation process whereby a specific cadre of medical researchers quite successfully used technical and rhetorical arguments to advance their agenda despite popular misgivings. While the Harvard Committee failed to prevent the intrusion of ethicists into medicine, it succeeded in its more immediate mission: establishing the scientific legitimacy of removing organs from certain hopelessly comatose patients, and thereby sanctioning an act deemed necessary for the therapeutic progress of organ transplantation. It was a profound coup of research interests to establish the concept of brain death as a clinical phenomenon, even if as a matter for further discussion, research, and refinement. The bulk of subsequent debate, even among the laity, has not questioned whether such a category *exists* so much as who exactly should be included in it and according to what criteria. Throughout the 1970s, the diagnosis of brain death was authorized by a series of legislative acts. While few clinical categories have received this degree of scrutiny, few also have won protection by law.

The brain dead were not discovered, but created by medicine. This creative act has two components. First, it is conventionally understood that the brain dead were created by technological accident, a byproduct of life support. Literally, the mechanisms of intensive care produced chronically comatose, respirator-dependent bodies. On a second level, someone had to create a social role to accommodate these strange bodies. In the case of the Harvard Committee's definition of brain death in 1968, the medical profession took the initiative to characterize them in clinically useful terms. A close examination of the Committee's discourse reveals the strategic negotiations behind the redefinition of death.

The irreversibly comatose embodied both opportunities and problems for providers. They were diagnostically and therapeutically challenging, marking the frontiers of experiential assessment and therapeutic revival. Economically, they were reliable consumers of medicine's most expensive services. However, they were burdensome. When they could not be restored heroically, they became an embarrassing liability to the profession's humanity and competence. The high cost of marginally beneficial treatment might appear obscene. Most decisively, these comatose were indispensable resources for experimental therapeutics (transplantation) which promised to elevate rather than undermine medicine's popular esteem. The Harvard Committee artfully chiseled the features of death from the form of coma. Accommodation of the complex demands of transplant research, the EEG, and a systemic commitment to technological proliferation served as the instrument, while the futuristic image of the organ donor, not a culturally traditional figure of death, served as template.[9] Representatives from humanities and ethics involved on the

Committee served to polish this figure to help present it as both modern and familiar, but not to stay medicine's formative hand.

The Committee successfully "introduced" and medically legitimated brain death, and concealed the demands of medical research in the articulation of the concept. However, the Committee did not entirely succeed in its construction of brain death. These dead remain unrecognizable by many physicians and much of the public. The Committee's construct succeeded not by directly addressing and resolving popular controversy, but rather by dismissing and excluding it from the deliberations of selected professionals with a common agenda. This analysis will show that the brain death of 1968 was created *by* a specific medical elite, *for* a specific medical elite (transplant pioneers). However, in ensuing decades, physicians have increasingly relied on brain death to support transplantation not only as elite and irregular research, but as regular therapy. The concept has not served this broader therapeutic campaign as well. A popular basis for brain death was not established by the Harvard Committee's statement. Whereas Harvard faculty intimately involved with medical research were able to agree upon a syndrome that looked like death for their purposes, this syndrome simply does not look enough like death to most people (including other physicians) for *their* purposes. The elements of the original cultural controversy, and a symptomatic resistance to the concept of brain death, still ferments among those excluded from Harvard's "multidisciplinary" effort, among them: citizens, patients, families, the news media, clergy, academics, rank-and-file physicians, and administrators.

II. Early Definitions of " Death" and "Brain Death"

Death was most frequently defined in medical dictionaries of the 1950s and 1960s as the cessation or absence of life, rather than in terms of a specific physiological event or criterion. However, corresponding dictionary definitions of "life" were so vague that they did little to frame their antithesis. In 1965, as in 1951, life remained defined as,

> ...the aggregate of vital phenomena; a certain peculiar stimulated condition of organized matter; that obscure principle whereby organized beings are peculiarly endowed with certain powers and functions not associated with inorganic matter.[10]

This definition did not indicate which organized matter, heart or brain, must be "peculiarly stimulated" for the condition of life to hold. In essence, death was defined as not-life, and life was defined as not-inorganic. Of course, one cannot follow the sparse logic in these definitions to deduce inorganicity as the criterion for death. Obviously, these dictionary definitions had little clinical value. Their ambiguity and lack of empirical precision implied perhaps that the definition of death (for the purposes of its determination) was delegated to professional authority rather than scientific "fact." Physicians retained the discretion to determine which "peculiarly stimulated conditions," powers, and functions separated the living from the dead.

Physicians did not use the term "brain death" to refer to a special criterion for death until the late 1960s . While "brain death" existed as a medical term before 1960, however, it referred to a process rather than a state of death. Hospital physicians recognized a syndrome known as "acute brain death" as a relatively familiar phenomenon; one physician saw thirty cases from 1945-1955 and noted the problem's significantly "frequent occurrence and dubious prognosis".[11] Acute brain death was an idiopathic syndrome in which a patient admitted for problems not primarily involving the central nervous system subsequently developed unexpected acute neurological symptoms (stupor, convulsions, coma), and died. This type of "brain death" bears little clinical relation to today's definition of brain death. In these cases, "brain death" was determined after the fact of conventional death; it was the failure of the brain which finally brought about the cessation of heartbeat and respiration, and, ultimately, death. The syndrome united a diverse spectrum of hospital cases according to the similarity of acute symptoms immediately preceding death, and later according to postmortem histology findings.[12] Once thus defined, the discovery of the same histopathology in a case of a thirteen year catatonic stupor led researchers to conclude that "...the same type of degeneration of the brain may be consistent with life, even though the patient has characteristic, far-advanced, organic brain syndrome."[13] This statement further attests to "brain death's" dependence on the passing of conventional death for affirmation, as its other defining characteristics did not rule out life. Thus described, acute brain death of the 1940s and 1950s was only new in terms of its easy observableness in the hospital and histological description. People had no doubt been dying "brain deaths" for as long as diabetes, asthma, herpes, peritonitis, and other diseases had been causing deterioration of brain tissue. Its further description caused no change in conventions for the timing of death or management of the patient/cadaver, and it raised no controversy.

III. Death Criteria and 19th Century Roots of Professional Authority

Twentieth century struggles for technical authority and opportunity in the definition of death revisit themes from the 19th century, when medicine was building the professional hegemony it exercises today. These themes and their relevance to contemporary attitudes towards brain death have been treated thoroughly elsewhere; they will be outlined only briefly here.[14] The two primary fears inhibiting people from organ donation today, of being treated as dead while yet alive, and of premature death, have prevailed at least since the Enlightenment.[15] In the nineteenth century, the former anxiety found expression in the popular fear of premature burial. The problem might have been real; for example, during the relocation of a cemetery in 1896, authorities determined that 2% of its inhabitants had actually been alive at the time of their internment.[16] Anecdotal accounts of individual cases abounded in the press, pamphlets, and fiction of the time, and this sensationalism probably exaggerated the actual incidence.[17] For example, Edgar Allen Poe's semifictional essay, "The Premature Burial" vividly described the agonies of awakening in a coffin.[18] In the fictional drama of the premature burial, the villains were mysterious disease processes, and providence was the only hope of rescue. Greed played another villain. People regarded relatives, who traditionally attended with authority at the moment of death, with suspicion in medically uncertain cases where an inheritance was at stake. The empirically objective, monetarily disinterested physician again came to the rescue to add scientific as well as moral authority to the verification of death.[19] Medical authority stepped in to prevent misuse of the dying, and defuse this popular paranoia by the turn of the century.

The fear of abuse of the dying at the hands of greedy or ignorant caretakers did not flare again until the mid twentieth century, coincident with the emergence of organ transplantation in the 1960s. Ironically, this time the doctor played the villain's role, and the helpless patient depended on the advocacy of clergy, the law, and the emerging profession of medical ethics. With its revival came a new historiographic interest in eighteenth and nineteenth century fears of misdiagnosis of death. One such analysis posited a new explanation for the resolution of the fear, provocatively different from Alexander's medical authority model outlined above. Physicians John Arnold and his colleagues in 1968 ("The Year of the Transplant"[20]) proposed that the rise in the practice of embalming finally ensured death before burial and eased public concern by serving effectively "to remove any mistakes from public view."[21]

However, embalming cannot have removed mistakes from the public's imagination, which had accounted for the prevalence of the fear and the demand for both fictional and factual accounts, as well as policy safeguards. There is nothing intrinsically less disturbing about the possibility of being prematurely embalmed than of being prematurely buried. The fear that "they will do something to me before I am dead" could have quite naturally evolved from the fear of premature burial in the nineteenth century, to premature embalming in in the early twentieth century, to fear of premature removal of vital organs for transplantation in the mid-twentieth century. The absence of a documented cult of fear of premature embalmment analogous to the two others is better explained by Alexander's theory that medical authority in the determination of death preempted the possibility that anyone yet living would be delivered to the morgue for embalming. The strong role of professional authority in the management of death and its social meaning is also supported by James Farrell's analysis of the rise of the practice of embalming itself. Farrell determined that embalming was initiated by the emerging profession of funeral directors who sensed the value of adding this quasi-medical - and by association, professional - procedure to their practice.[22] The surgical and chemical manipulation of the body (indeed, to make it appear more lifelike) endowed morticians with a professional mystique, in the eyes of a public increasingly willing to defer to the tools, techniques, and technicians of "science" in cases of moral and emotional confusion.

Physicians in the latter half of the nineteenth century seized the opportunity to play the hero's role, commanding widespread recognition of their professional authority in return for a more "scientific" diagnosis of death.[23] Physicians gradually replaced laypersons in the supervision of the dying and the dead. Medical science abandoned its search for a single, simple sign of death in favor of a complex system of signs interpretable only by an expert in medicine. This change in research priorities was motivated not, as one might expect, by the scientific resolution that no simple sign existed, but rather by the profession's desire to remain indispensable in its newly acquired territory of professional authority. The founder of the Paris morgue in 1870 argued illustratively: 'Suppose for a moment,' he suggested, 'that a sign of death obvious to the whole world was discovered. What would happen? *Persons wouldn't call a physician to verify death...* Let us therefore abandon the unfortunate idea that the signs of death must be vulgarized'.[24] Medical examiners replaced lay coroners, and physicians established and supervised mortuaries where the dead could be observed for signs of life before burial.[25]

IV. Transplantation Research Before 1968

Elite medical researchers and their institutions, led in the United States by Harvard University, introduced technology of organ transplantation into clinical practice in the 1950s. The procedure became mechanically feasible through advances in surgical technique, but remained therapeutically limited into the 1970s by unsolved problems of immunological barriers and graft rejection. Transplantation between individuals was possible in cases where physiologically "dead" tissue was used, or living organs came from immunologically compatible (i.e., living related) donors. Techniques for grafting immunologically insensitive tissues such as skin, bone, cornea, heart valve, and other connective tissues developed dramatically, in part relying upon valuable experience from the treatment of WWII casualties. These technologies did not require the use of brain dead cadavers; donors were either indisputably alive or conventionally dead.

The first kidney transplant, between living twins, was performed by Joseph Murray's Harvard team in 1954. Advances in immunosuppression allowed the first transplantations of kidneys from cadavers to genetically unrelated recipients in the early 1960s, and while the kidneys did not need to come from heart-beating cadavers, "fresher" organs made more viable grafts. By 1963, almost 250 kidney transplants had been performed worldwide, 30 of them between identical twins.[26] Basic research on animals explored the possibility of transplanting myriad body parts which today would seem unlikely prospects, including whole limbs, digits, breasts, teeth, uteruses, and brains. Prospects for human clinical trials at the time included transplantation of the liver, heart, brain parts, lungs, bone marrow, intestine, connective tissue (skin, bones, limbs), hair, and various endocrine glands including the gonads.

In the early 1960s, not the heart but the lung was envisioned as the next prospect for therapeutic transplantation. In 1963, James Hardy transplanted the first human lung;

the recipient died 18 days later from kidney disease without signs of rejection or failure of the transplanted lung. By 1970, 25 patients worldwide had received transplanted lungs.[27] Basic research in heart and lung transplantation thrived through the 1950s and early 1960s. Hundreds of trial operations were performed on dogs, and sometimes in human cadavers. Surgeons such as James Hardy at the University of Mississippi and Norman Shumway at Stanford University ambitiously refined their heart transplant techniques during this time, "standing by" for the fortuitous circumstances which would make the first human heart replacement possible. James Hardy in Mississippi replaced the human heart for the first time in 1964, by transplanting a chimpanzee's heart into a man. The too-small primate heart could not sustain the circulation of the patient, who died within hours of the surgery. South African surgeon Christiaan Barnard performed the first human-to-human heart transplant on December 4, 1967. The details and significance of this event will be discussed below.

The goals of organ transplantation intimately interacted with the medical definition of death before the famous Harvard Committee "first" defined brain death. Before 1968, medical professionals promoting brain death interested in the concept for solving several dilemmas in transplantation. Although part of the perceived transplant phenomenon, the pursuit of heart transplantation did not impel a redefinition of death at this early point. Rather, it was the shift to use of the dead as organ, primarily kidney, sources. Organ grafts from living relatives were least often rejected by the host. However, restricting transplants to people who could secure a live related donor meant that the technology would not be available to many people who might benefit from it. Live donors also posed an ethical problem: in removing organs, physicians maimed healthy people. Cadaver sources promised to solve both the problems of limited organ supply and harming healthy bodies.

However, cadaver grafts were less viable in these early days, and threatened the efficacy of the still experimental treatment. Cadaver organs were inferior to live donor grafts in two ways: first, immunosuppression was crude and poorly understood, thus rejection of the genetically dissimilar tissue was likely, and second, tissue from dead bodies was less "fresh" and healthy, more vulnerable to disease and dysfunction. The former problem would be solved in the laboratory. The latter problem would be partially solved in the reconceptualization of death, first in open academic forums such as the Ciba symposium, and later by the Harvard Committee in a discursive exercise reminiscent of a retreat to the laboratory.

V. Formulations of Brain Death for Organ Procurement Before 1968

In March of 1966, the Ciba Foundation held an international symposium on the topic of "Ethics in Medical Progress: With Special Reference to Transplantation." The small, select group of participants from Europe and the United States included 20 physicians (at least 3/4 of whom were actively involved in transplantation, 4 legal scholars, a journalist, a theologian, and the Director of the Ciba Foundation. One of the participants, transplant surgeon Joseph Murray, would later serve on the Harvard Committee. At the symposium, brain death for the purposes of organ procurement was discussed explicitly and candidly, and Ciba subsequently published the transcripts of these talks. Among the questions posed for discussion were, "...for how long should 'life' be maintained in a person with irrevocable damage of the brain?... when does death occur in an unconscious patient dependent on artificial aids to circulation and respiration? are there ever any circumstances when death may be mercifully advanced?"[28] The following analysis of such discussions before 1967 outlines some of the early issues that brought transplant professionals to focus on brain death, and the metaphors and models which organized their understanding of the problem.

The necessity of maiming live donors to get viable kidneys created the central ethical dilemma of kidney transplantation in the mid-1960s. Such a surgical operation legally and morally constituted "assault" unless it was for the express therapeutic benefit of the subject and not someone else.[29] Consequently, the removal of a kidney from a healthy person to benefit another was a clear violation of the ethical imperative *primum non nocere* - "first, do no harm." This artificial tradeoff of welfare between bodies deeply troubled transplant surgeons, although not deeply enough to abandon human transplant experimentation. Cadaver sources promised a way around this problem, as one could not technically harm the health of a cadaver. However, this raised a new clinical hazard:

conventional cadaver organs were less healthy than live organs and compromised the survival rates of clinical trials. Organs from heart-beating cadavers would solve this particular problem, but not without either compromising therapeutic obligations to dying patient, or a redefinition of death. The former solution of abandoning hopeless patients and harvesting their organs would bring surgeons back to the original problem of harming one patient to attempt helping another. Consequently, the redefinition of death would provide the most complete conceptual resolution to this ethical conundrum. Nevertheless the concept never became "clean" enough to keep other ethical taboos from interfering, such as prohibitions against mutilating corpses, bodysnatching, professional conflicts of interests, and so forth.

Joseph Murray, a prominent kidney transplant surgeon at Harvard, was morally committed to improving cadaver sources in order to avoid live donations altogether.

> As physicians motivated and educated to make sick people well, we make a basic qualitative shift in our aims when we risk the health of a well person, no matter how pure our motives. To relieve ourselves of this responsibility all clinicians working with kidney transplantation should strive for better organ procurement so that the day will come when even the identical twins will not require a living donor.[30]

Murray became a strong proponent of the redefinition of death. Such a conceptual shift would ensure that there would be a supply of healthy, functioning bodies (without minds) which would not be maimed, but rather simply disposed of in the process of organ procurement.

Ciba symposium discussants hypothesized various social roles for the both living and cadaver donors, trying to find one which best supported the act of organ procurement. The strategic goal was to transform the removal of healthy organs from an act of "mutilation" into a "benefit" to the donor, not just the recipient. Live donors were posited as psychiatric patients, spiritual seekers, and even professional "colleagues." The emotional benefit of giving was medicalized in order to compete formidably with the taboo against submitting oneself to be maimed:

> The Massachusetts decision which allowed the first transplantation was really a way round [the legal prohibition against consenting to harm oneself for another's benefit], because it was decided that the operation would be for the psychiatric benefit of the donor.[31]

By removing and transplanting a healthy kidney, physicians not only might treat the donor psychiatrically, but minister to them spiritually:

> ...[might not] kidney donation... be justifiable on the principle of totality? That is, spiritual good is better for an individual than material good and even though the donor has lost something materially he has gained something spiritually which is greater.[32]

Joseph Murray particularly appealed for theological sanction of the act of kidney donation. As part of such an entreaty to a Catholic audience in 1964, he appealed to the spiritual concept of the body as a gift *to* the person, not a possession *of* the person: "As humans we merely exercise stewardship, not mastery, over our bodies, and hence do not have *absolute* freedom concerning their disposition."[33] At the Ciba conference, Woodruff suggested the analogy of military obligation to risk oneself for the benefit of others:

> People are worried about these moral problems, but during the Battle of Britain was there any moral problem about allowing somebody to become a fighter pilot? I would sooner have given a kidney than become a pilot. What is the difference?[34]

Alternatively, the donor might be promoted to "colleague" status, joining the transplant team through due heroic sacrifice:

> If the two operations [organ removal and implant] were treated as a single action, the danger would be that the human rights of the donor might be overlooked. Unless perhaps he could be regarded as a member of the curative team: he would in a sense be a colleague of the surgeon.[35]

Transplantation was not only on the agenda of physicians seeking heroic interventions, it also served broader technological interests of national security and even perhaps expansion into space. Harvard Committee member Joseph Murray's transplantation research at Harvard was supported in part by the Atomic Energy

Commission and the United States Army. Along a theme of the progress of civilization itself, Murray closed his Ciba symposium presentation on the "practical possibilities" of organ transplantation with the following whimsical vision of the future:

> It is conceivable that for the needs of space travel, completely unanticipated physiological requirements may be met by the grafting of accessory organs, such as extra adrenal glands to overcome the stress of the environment on the moon, accessory lungs to accommodate the atmospheric conditions on Venus, or accessory extremities with which to crawl around on Jupiter.[36]

Transplantation was not only good for individual patients, it was good for humankind in terms of the scientific knowledge it produced and the new technological capabilities it might create.

Artificial organ technology constituted another research agenda intimately involved with both the pursuit of transplantation and the reconceptualization of death. The science of organ replacement had become a hot area in medical research after WWII. Researchers explored not only the possibility of transplanting organs between individuals, but of replacing the function of vital organs with drugs, or replacing whole organs themselves with machines. Both realized and envisioned achievements in the field of artificial organs affected work on organ transplantation on many levels. Temporary life support, such as heart-lung machines, made open heart surgery possible. The artificial kidney increased the longevity of end stage renal disease patients, increasing the demand for kidney transplants. Artificial respiration replaced the function of the lungs in cadaver organ donors and surgical patients alike. Heart defibrillators and pacemakers restored function after cardiac arrest. The ready armamentarium of intensive care machines supported more invasive, debilitating surgeries; life support could rescue the postoperative patient from serious complications such as respiratory, heart, or kidney failure.

These intensive new medical technologies developed in symbiotic interdependence; advances in one area made possible advances in others. This gave a hopeful cast to *all* research endeavors on the horizon of organ replacement - even marginal therapeutic achievements might usher yet unenvisioned breakthroughs. This network of research and clinical interests was described by Joseph Murray at the Ciba symposium:

> The study of transplantation biology collects a diverse tribe, or possibly a galaxy, of scientific disciplines. The pathologist, microbiologist, biochemist, geneticist, zoologist, internist, physiologist, surgeon, pharmacologist, radiologist, virologist, and veterinarian all have a notable interest in this search for the essentials of one's own biological identity. Advances in any of these disciplines will influence the entire field, and only the most unimaginative would freeze our thinking within today's body of knowledge.[37]

Nevertheless, the "cutting edge research" image of transplants sometimes conflicted with the "heroic care" image, as the public worried about researchers subordinating patient care to research interests. The American surgeon W.E. Goodwin called attention to this public relations problem:

> As our thinking about transplantation of human organs develops, people must become enlightened enough not to think of this as a horrible experiment, or indeed as an experiment at all, but learn to accept it as a normal event.[38]

The definition of a medical "experiment" became a politically charged controversy in the 1960s. Transplant surgeons for the most part believed that a lifesaving motive ethically privileged all attempts at transplantation as therapeutic, rather than experimental in nature. Yet, medical professionals conspicuously lauded transplant successes as innovative breakthroughs. Different ethical imperatives operated, depending upon where transplantation belonged in the experiment-therapy dichotomy. Physicians faced the central question of whether they might risk the health of transplant donors or recipients in the interest of science. Historians of transplantation Fox and Swazey have recast this experiment-therapy dichotomy as a continuum, as the criteria for classification were unclear and much of therapeutic progress was incremental. Transplant professionals at the Ciba symposium disagreed amongst themselves as to what features of their practice defined it as experimental, suggested criteria included: low success rates, therapeutic intentions, and data-gathering interests.

The replaceability of organs or their functions had varying effects on the practical possibilities of transplantation, depending upon the organ being transplanted and the organ in which the essential signs of death was located. First, the therapeutic alternative of an artificial organ might decrease the impetus to transplant by circumventing the hazards and controversies involved in immunosuppression, organ procurement, etc. However, artificial organs also sustained patients awaiting transplants, and as long as the transplant promised the more effective therapy, this practice of "bridging" would increase the demand for organs and transplant operations. This was the case with the artificial kidney, and later with the total and partial artificial hearts. Transplantation provided a "backup" therapy with which to rescue patients in whom experimental artificial organs, such as the heart, failed. The converse expectation also prevailed, that perfected artificial organs in time would make transplantation obsolete. Paradoxically, this expectation increased tolerance for problematic, "halfway" effectiveness in heart transplantation: if it were merely a temporary stopgap measure, it need not be perfect, and it was indispensable as a supportive measure for the development of its technological successor, the artificial heart. However, in kidney transplantation of the mid-1960s, the imperative worked in the opposite direction. Dialysis was more effective and available than the early transplants, making all the more questionable the "therapeutic" motives behind transplant trials and especially live organ donation.[39]

In all, transplantation had much to gain technically from adhering to a definition of death that depended upon the dysfunction of the brain and not the viability of other, transplantable tissues. Transplant physicians began promoting brain nonfunction as the defining characteristic of death. One of the early published descriptions of brain death attempts simply to reconceptualize conventional heartbeat-based criteria in terms of brain death. In his book surveying transplantation, Moore described death criteria as follows:

> ...there is absolute cessation of brain function, reflexes cease, the pupils become widely dilated, the electroencephalogram shows no activity, and the patient indeed is dead. But he is not pronounced 'dead' by the attending doctor unless his heart has also stopped beating... Cessation, alone, of the heartbeat for a moment or two does not signify death, nor does it inevitably bring death... If, however, this cessation of heartbeat persists... the patient is dead because the brain is dead... for most mortals coming to the end of their lives, the cessation of heartbeat, respiration, and brain function occurs within a few minutes, and no one knows which ceased first unless there is close observation and special electrical apparatus is employed.[40]

In short, cessation of heartbeat is only "death" because it causes destruction of the brain, the "true" criterion of death. This formulation did not solve the problem of heart procurement, as it did not take the reasoning the necessary next step to propose that brain death in the *absence* of heart death was indeed "death." Later in the book, Moore discusses the dubious promise of heart transplantation, noting that,

> Donors for the heart present a very severe problem...one cannot truly call a patient 'dead' until the heart has stopped beating...It is evident that severe problems exist here, soluble only with remarkable sophistication in concept and method.[41]

Specific criteria for brain death were introduced at the Ciba symposium by Dr. Alexandre. Revillard and Murray in particular endorsed the development of new criteria for death and offered their suggestions for its modification or clarification. A schematic overview of these and other brain death criteria published the medical literature up to the Harvard criteria of 1968 appears in Appendix 1. As described above, Moore's early description of brain death in 1964 included verification through eventual cessation of the heartbeat; brain death thus signified "death" through its contiguity with conventional death. Alexandre's criteria, which he and colleagues had already applied in the case of potential organ donors in France, included absent reflexes, dilated pupils, flat EEG for several hours, no spontaneous respiration for a period of 5 minutes off the respirator, and falling blood pressure. This last criterion indicates that conventional death will inevitably follow within hours. These early criteria were also closely linked to conventional death; hopelessness was irrefutable in the case of falling blood pressure as the rest of the body, not only the brain, was clearly dying. Revillard rejected the criterion of falling blood pressure, as "...the fall may often occur later than the other signs, and in some cases the blood pressure remains at 100 mm. for several hours."[42] He did not elaborate on why the wait was unacceptable.

The Harvard criteria would further distance the timing of brain death from the eventual cessation of the heartbeat, effectively allowing more time for verifying the death diagnosis and for preparing for transplantation. To restore a level of certainty about the irreversibility of the coma at this earlier stage, Harvard added the criterion of etiology. This effectively ruled out two reversible conditions with the same signs as brain death: deep comas due to CNS depressants or hypothermia. The trend has continued; contemporary proposals to modify brain death criteria typically attempt to further temporally distance brain death from its inevitable consequence of coporeal death, not by hours or days, but by months or even years. The underlying criterion of "irreversibility" has indeed created a conceptual "slippery slope," inviting more terminal conditions such as persistent vegetative states or partial brain damage to become "updated" formulations for brain death.

Some physicians attending the Ciba conference protested the redefinition of death. A common allegation was that brain death proponents held a double standard, that they only promoted the criteria in the interest of procuring organs, and would not tolerate such criteria applied to themselves . British surgeon R. Calne commented to his colleagues, "...I am sure that the public would at present reject Dr. Alexandre's criteria of [brain] death. I wonder how many of this presumably enlightened audience would be prepared to donate their kidneys under Dr. Alexandre's criteria?"[43] Thomas Starzl mused, "The notion of permitting removal of our organs while we still have a circulation is an important one. Personally I would agree to this for myself, but I could not permit this to be done to a member of my family."[44] This prominent American pioneer of transplantation came out in opposition to redefinition of brain death, but not necessarily against the practice of removing transplantable organs from irreversibly comatose patients: "I assume that when kidneys are removed from 'living cadavers' [in France], only one organ is removed, so that the patient is not thereby killed."[45] Calne noted the potentially scandalous appearance of opportunism if death were redefined specifically in response to the need for organs, rather than in the interests of all patients on terminal life support:

> I am sure we would all agree that there comes a time when it is in the interests of the dying person and the relatives to 'turn off the switch'. But the point that is important is whether this is being done because one is looking for a kidney rather than because it is in the interests of the patient who is dying.[46]

Objections to the redefinition of death did not stem only from a "shadow of a doubt" that the irreversibly comatose patient may yet be alive. The redefinition of death posed practical problems which might potentially backfire actually to interfere with transplantation. One was the concern that a lack of consensus on controversial signs of death would harm the reputations of doctors who opportunistically insisted that potential organ donors were "dead":

> Although Dr. Alexandre's criteria are medically persuasive, according to traditional definitions of death he is in fact removing kidneys from live donors. I feel that if a patient has a heart beat he cannot be regarded as a cadaver. Any modification of the means of diagnosing death to facilitate transplantation will cause the whole procedure to fall into disrepute with the rest of the profession... [heartbeat based] criteria would be accepted by everybody as definite evidence of death [in the event of discontinued life support]. Dr. Hume, who has a large and successful experience of cadaver transplantation, does not start to removes the kidney until the heart has stopped beating.[47]

A practical solution was to declare the patient hopeless, discontinue life support, and await conventional "death" vigilantly, so that the organs could be taken the moment the heart stopped. This approach was not necessarily more morally "conservative" than would be a redefinition of death. The removal of life support had the effect of ending the patient's life, if somewhat passively.

For paired organs, such as kidneys, lungs, or parathyroid glands, leaving one organ intact ensured the safety of the donor and avoided the possible equivalence of vital organ removal with "killing" a patient. Murray incorporated this ethical feature into his formulation of a prospectus for the future of transplantation, predicting the lung to be the next most transplantable organ after the kidney:

> ...it is the kidney which is the current-day 'prototype' of the 'spare part' organ. Kidneys come in two's, and a person can live normally on one.
>
> ... the lung is the next most likely organ to be transplanted. Sporadic attempts have been made, none successfully. The lung is also a paired organ... Of the non-paired organs, the liver seems the most feasible for successful transplantation.[48]

Another practical concern was legal access to the body. Live "patients" were the wards of physicians, while "corpses" belonged solely to the next of kin. Once death was declared, physicians no longer could manipulate the body at their own discretion, in the therapeutic interests of either the corpse or a potential organ recipient. In response to the criteria for death proposed by the Belgian Dr. Alexandre, a Swedish physician remarked,

> If you have decided upon what is life and what is death then you have the right to take an organ from the dead body, even if someone else thinks the person is alive... [these new criteria say] that a person who is still alive by the old criteria is really dead, while we want to have the person looked upon as living as long as possible, so that the relatives cannot come and say, 'He is dead and you are not allowed to take anything.'[49]

The Scottish legal scholar and Chair of the Ciba symposium, Lord Kilbrandon, offered physicians a devious suggestion for getting around the problem of family permission to mutilate the corpse: "If the organ is removed discreetly and the body is handed over in the ordinary way, who is a penny the worse off?"[50]

Physicians and legal scholars at the Ciba symposium debated who in society ultimately had the right and the expertise to redefine death. Legal scholars advised the medical profession to take the initiative. Several researchers recognized that their activities might be threatened by outside directives not guided by medical concerns. Yet, other physicians saw the definition of death as not solely a medical issue, but a broader philosophical undertaking that should be burdened by non-medical professionals as well.

In all, professionals concerned with transplantation in 1966 were content to let the brain death debate simmer for some years before seeking either professional consensus or legal sanction. In the meantime, of course, brain death proponents would continue to remove vital organs from heart beating cadavers, and those opposed to the practice would make due with the less viable organs of the conventionally dead. Despite recognition and concern about the problem, there was no sense of urgency within the profession to redefine death. A British medical scholar summarized the professional strategy:

> Opinion [regarding brain death and ownership of the body] in this room is probably a good deal in advance of public opinion... It may be dangerous to get the legal situation too carefully tied up at this stage. It might be better to go on doing what we are doing according to our own consciences and hope to keep out of the hands of the law for at least another five years.[51]

Transplant researchers were able to "keep doing what they were doing" for only a little over one year, until the first heart transplant exposed the practice and thereby threatened the "dangerous" legal sanction. This exposure created an unprecedented urgency for the redefinition of death. Physicians nevertheless continued discussing the practical and philosophical premises on which a new definition of brain death might be constructed. Themes in these speculative debates included the medical replaceability of human function, the features of death conceived as a process rather than event, and the possibility of death verification by EEG.

Artificial organs not only affected transplants through their relative efficacy, as mentioned above, but interplayed with transplantable organs in the location of the signs of death. Physicians were concerned that removing an essential vital organ effectively "killed" the patient, a blatant violation of medical ethics (not to mention most religious injunctions and laws). This held whether the organ was removed from donor or recipient. Physicians and ethicists considered the question two ways, 1) might replaceability of the organ's function make the act technically not killing, because the patient could be resuscitated, and, 2) if resuscitation or replacement of the organ's function were technically possible, would that invalidate the traditional location of "death" in that organ,? For example, cessation of breathing, a popular sign of death, became obsolete with the possibility of artificial respiration. With artificial hearts around the corner, the heart could become analogously obsolete. This "progress" in concept would simultaneously solve several dilemmas in heart transplantation: the brain, not the heart, might become the center of death, beating donor hearts might be procured, and removing the potential recipient's ailing heart would not constitute murder if the transplanted heart failed. Ironically, the *limitations* of artificial heart technology were also used to justify the quest for fresher organs, on the grounds that the recipient's heart might only be justifiably removed if a truly viable graft were ready.[52] Otherwise, the failure of the graft could not be compensated by artificial means, and the patient would die.

Conversely, transplantation offered the possibility of rescuing human subjects from failed artificial organs and other bold surgical experiments. This has been particularly true of the relationship between transplantation and the artificial heart, as well as transplantation and open heart surgeries such as coronary artery bypass grafting. Researchers could better afford to initiate human trials when backup treatments were available. The symbiotic support between artificial organ investigation and transplant research thus ran both ways: while the artificial kidney (dialysis) allowed bolder trials of kidney transplantation, heart transplantation would in the following decades encourage research on the total and partial artificial heart.[53]

Transplantation of the brain was similarly evoked in discussions of the location of death and the frontiers of transplant technology. The irreplaceability of the brain's function made it a prime candidate for a new location for death. A more recent historical analysis of brain death criteria illustratively asserts that life should be located in the human being's "critical system," defined in part as "...that system which is irreplaceable by and artifice, be it biological, chemical, or electromechanical."[54] Popular as well as professional discussions of the meaning of heart transplants sometimes conflated the problem of locating death in a particular organ and the problem of transplanting it. Interestingly, transplant professionals pointed to technical difficulty, not the obvious ethical problems, to assure that brain transplants would not soon become practice. The question was not whether society would allow such pursuits, but rather whether such "purely technical" investigations might inadvertently yield a social problem:

> The moral and philosophical problems that potentially would ensue if brain tissue were transplantable - such questions as the identity of the personality itself - may at least at present be relegated to the area of the fanciful. There is no evidence that brain tissue would survive transplantation. In fact, apparently brain tissue cannot renew itself within the individual.[55]

> The one organ we probably won't be able to transplant is the human brain, not so much because of the technical difficulties, although those would be very great, but because the brain is, so to speak, a telephone exchange and the difficulty would be to get all the wires connected up again.[56]

In turn, if the brain were to become the new locus for death, this itself might prohibit progress in brain transplant technology because by definition all cadaver brains would be dead brains and unsuitable for transplantation. Moore considered this possibility:

> Donors of brain present seemingly insuperable problems. Obviously, one cannot say that a person is dead until the brain is dead, in which case it would be no good for transplantation. Secondly, the tissues of the central nervous system are slow to regenerate and in many cases do not regenerate at all... Homotransplantation of the whole brain seems to be nothing but idle chatter; if it were accomplished, the recipient would be a different person.[57]

Proponents of brain death called for the reconceptualization of "death," as a process rather than as a discrete event, allowing a convenient conflation of prognosis and diagnosis. To be irreversibly or hopelessly comatose was tantamount to being dead already; if you were on your way, you were "there." Likewise, brain death advocates called for the relocation of "life" in the organization of physiological systems, rather than in a particular vital organ. Living organs did not indicate a living body, and even a living body did not necessarily indicate a living "person" if the brain had died. The living person was clearly "greater than the sum of his/her parts," while the brain dead body was precisely the sum of his/her parts. With the integration of the person gone, those parts became "spare parts."

Professionals disagreed about the natural course of the brain death process. The relationship between conventional death, ceased heartbeat and respiration, and the death of the brain was well known to be a matter of minutes. However, physicians and policymakers made vastly differing assumptions about the reverse phenomenon, the time between brain death and inevitable death of the rest of the body. Some assumed that the heartbeating cadaver would remain so for the duration of life support - whether for hours, days, months, or years. This appears to have been a physiological impossibility in the case of true complete deterioration of brain tissue. French physicians at the Ciba symposium, who included falling blood pressure as a criterion for death, described a brain dead body that would inevitably conventionally die within hours. Later criteria, such as Harvard's, described the symptoms of a brain at an earlier stage of demise; confirmation of signs in the body could be made after 24 hours. The earlier "hopelessness" could be determined, the more control physicians would have over the disposal of healthy body parts. Organ procurement and transplant involved planned, coordinated activities that could be accomplished more smoothly in a matter of days than in a matter of hours. The Harvard criteria were consequently concerned with possible recovery, and added in its criteria an knowledge of the etiology of the coma. Comas caused by drugs or hypothermia might "mimic" the character of earlier brain death.

At the other extreme, some assumed that life support retained complete control over the brain dead body, as well as its physiological and organizational destiny. The operation of machines had apparently completely replaced the natural course of death; in the modern world, organizational decisions and not physiology would determine when bodies were ready for the grave (and perhaps organ removal). This assumption evoked macabre visions of hospitals filling up with heart beating cadavers who would languish there for decades, unless something strictly organizational - like a redefinition of death - were done to prevent it. A legal scholar for instance commented at the Ciba symposium:

> Is death, then, to be defined as the moment at which irreversible destruction of brain matter, with no possibility of regaining consciousness, is conclusively determined? Yet people have lived for months or years after head injuries with such brain destruction...and it has not been suggested that death has virtually occurred in these circumstances.[58]

This image would emerge again in the promotion of Harvard's criteria. Physiologically, the brain dead as defined in the 1960s and the chronically comatose were different. However, even "people who knew better" (including physicians such as Henry Beecher, the Chair of Harvard's committee on redefining death) sometimes evoked the image of the chronically comatose to argue for a redefinition of death. Popular impressions of decades-long comas, and the rhetorical use of chronic coma as a "poster child" for brain death, will be analyzed below.

Doctors looked to the flat electroencephalogram for graphic representation of the moment of death. However, in the absence of knowledge about the physiological process of death and no consensus about precisely where in the process death should be located, there was debate about the instrumental validity EEG readings. The EEG produced the desired "flat line," but how long should the line be to constitute a picture of death? How many pictures should be taken - i.e., was the instrument reliable? What of life might be inadvertently left out of the picture - i.e., was the instrument valid? These questions were raised but not answered at the Ciba symposium, calling for further research. Yet the EEG promised a basis of authority for medical redefinition of death:

> Some biologists accept one minute of EEG silence as incontrovertible proof of death. Others accept three minutes, or five minutes. Whatever anyone wants to make it, there ought to be a mechanism for collecting affidavits from all the scientists qualified to speak to this point with authority, so that a medical definition of death can be reached which would, in effect, have legal force. Then if law and society brush aside some of the archaic rules concerning anatomy, it seems to me that the whole ground-work will be laid for cadaver transplants.[59]

EEG evidence and scientific consensus seemed to ensure the medical category of death an epistemological force which would overwhelm any incompatible concepts in law and society.

At the time of the Ciba conference in 1966, the term "brain death" had not been coined. Participants did not explicitly discuss terminology for the new concept. Just as various criteria for death were proposed, various terms arose to describe the heart-beating, brain-dead organ donating body. Those who were not willing to dub these bodies as "dead," yet were willing to employ them as organ resources, devised awkwardly descriptive labels. The oxymoron "living cadaver" often appeared in quotation marks. Part of the problem was the conceptual paradox that, although death was being reconceptualized as a process, it was still necessary to identify and label the body as in a specific state in order to declare him/her "dead." This state was defined according to static diagnostic criteria for brain death. However, transplant surgeons tellingly labeled the bodies not in terms of their state, but rather in terms of their prognosis and potential role as an organ donor. Some employed the medicalized term, "heart-lung preparation," as in Starzl's question "How long did your patients continue to be *heart-lung preparations*...?" and Alexandre's response, "... In my opinion it is irrelevant whether a heart-lung preparation goes on for two days or even for weeks: it is still a *heart-lung preparation* and for us it is still a *dead person*."[60] The epitome of this process dependent descriptor was uttered by brain death proponent Revillard: "I would like to draw attention to the difference between prolonged comas and *the potential cadavers who are almost heart and lung preparations*."[61]

The medical problems of progress in transplantation were not only technical, but strategic in terms of balancing ethical duties and credibility with the risks of human experimentation. Researchers strove not only to solve immediate scientific problems; they also diligently strove to bring admiration rather than criticism to some dramatic human experimentation. The Ciba Symposium discussants quite candidly acknowledged and pondered the relationship between basic scientific problems and public relations, due to the fact that scientific categories did not fit with popular cultural categories. Surgeons mechanistically replicating and replacing body parts violated the popular sense of bodily integrity. In "procuring" organs, researchers violated deep taboos against mutilating both living and dead, and it became apparent that the ethos of technological progress did not easily triumph in this case.[62] In 1966, physicians seemed to expect a rational resolution of ethical problems. The artifice in the Ciba deliberations was vigorous debate, in effort to deduce ethical guidelines from technical circumstance.

However, two years later, in the Harvard Committee's deliberations, researchers would take greater care to contain their doubts behind closed meeting room doors, and assert to the public and their colleagues a more professionally and technically fortified theory of death. The artifice in the Harvard deliberations would not be the articulation of sound reasoning, but rather its oblique *implication* the appearance of solid, authoritative consensus. Whereas the Harvard Committee has been characterized as a milestone of intrusion into medical autonomy, in its conceptual license this committee was a far more professionally controlled, autonomous body than were physicians at the earlier Ciba forum. Although elite professionals composed the group, the rhetoric of the Ciba conference had more of the democratic air of a town meeting. In contrast, Harvard's work had a technocratic ethos more characteristic of a retreat to the laboratory, for a the secretive, methodical, expert distillation of a newly recognizable scientific "fact".

It is apparent from the proceedings of the Ciba conference that by 1966, some European and American physicians had already applied brain-based criteria in the determination of death, and procured kidneys from heart beating cadavers. This practice was *not* introduced with the first heart transplant in 1967, as commonly believed. Rather, in 1967 and 1968 the sudden publicity forebode a possible scandal for the field of transplantation. What medicine had reserved as a medical issue was suddenly exposed as a larger ethical question. As a proactive response to this threat, Harvard took measures to protect and even promote the practice by institutionalizing it as a medical protocol. The Harvard Committee definition repackaged brain death, this time for the public, as a quintessentially medical issue.

VI. Images of the Comatose Before 1968

The problem of just resource allocation permeates contemporary health policy, and has frequently entered debates of recent decades about broadening brain death criteria or even promoting euthanasia. Rationing scarce resources and fair access to expensive technology treatment also emerged as issues in the 1968 brain death definition by the Harvard Committee. In these formative years for the professions of medical ethics and health economics, bluntly utilitarian reasoning drove the discussions. Henry Beecher wrote in justification of his committee's brain death criteria,

> ... I do not think it is crass to speak of money here, because if we had more money, we could save more lives in hospitals. If the average hospital stay is two weeks, the irreversibly unconscious person has then occupied space that could have been occupied by 26 others in a year's time. Not long ago the Times in London reported the death in Montreal of a 21-year-old woman who had been unconscious since a traffic accident 12 years earlier. Then, if you will accept my calculations, she kept 312 patients out of a hospital bed.[63]

The application of this argument to brain death per se was either purely rhetorical, or reflected an ignorance of the clinical prognosis of the brain dead as defined by the Committee. The particular form of "irreversible unconsciousness" defined by the Committee's brain death criteria has been demonstrated to lead inevitably to conventional (heart) death within one day to one week at the longest, regardless of the extent of life support.[64]

Nevertheless, the specter of hospitals filled with virtual corpses was provocative at a time when equitable access to medical care was becoming politically popular. What was the nature of the "problem" of the terminally comatose inpatient at the time? And what was the relative importance of utilitarian concerns about health care spending versus utilitarian concerns about organ transplantation in the redefinition of death?

Physicians increasingly treated dying hospital patients with intensive technology through the 1950s and 1960s. Hospital intensive care units (ICUs), institutionalizing the state of the art in technological life support, first appeared during World War II. By 1951 about 20% of moderate to large community hospitals included ICUs, and by the early 1960s virtually all hospitals employed ICU technology, at least in the form of postoperative recovery rooms.[65] In 1956, the *New England Journal of Medicine* published an intern's poetic tribute to the serenity of hospital death:

> ...She dies so well, dwindling unaware
> To coma as to sleep with little play
> Of words. She's little left with which to care.
> I hear laments but no disturbing cries;
> This is the way a civilized person dies.[66]

To some, then, intensive care technology sustained life comfortably if not vitally in the face of extreme pathology. Up to this time, the profession as well as the public rarely questioned "miraculous" terminal life support systems as inhumane.

However, a year after the publication of the intern's poem, a popular magazine published a widow's emotional account of her husband's hospital death, an indictment of modern medicine's ability to draw death out into a prolonged physical ordeal and human indignity.[67] Reprinted in *Reader's Digest*, the article received wide exposure and mixed responses from doctors, clergy, and the dying.[68] It shortly became the topic of a *New England Journal of Medicine* editorial, in which the editor recommended the piece as "required reading for physicians."[69] The editor expressed special concern for the physician's benevolent image when a "half-dead" person is, "...[kept alive] so long that the doctors may emerge in the eyes of kin with little resemblance to the wise and understanding family physician of yesteryear... this decrease in dignity and rapport with the bereaved seems in inverse proportion to the efficacy of the medical sciences to prolong life."[70] Medicine's heroic measures were beginning to give the heros a public image problem. The perceived crisis was not the ambiguity of the patient's alive-versus-dead status, but rather the lay public's horror of hospital dying and new mistrust of the doctor's role in prolonging it.

Early criticism of prolonged life support in the 1950s thus centered not on the appropriate determination of death, but the extent of the doctor's opportunity and obligation to postpone it. A group of anesthesiologists posed the ethical problem of medical prolongation of life to Pope Pius XII. The Pope delegated the dilemma back to the doctors, affirming that the criteria for timing death should be left to the professional expertise of the physician.[71] The Pope's 1957 statement became the only reference cited in the landmark brain death definition published by the Committee in 1968.[72]

At the time, however, neither the press nor the medical profession perceived the statement to call for redefining death per se. The Pope's statement in fact formed an ambiguous precept; prominent newspapers reported directly contradictory interpretations of the policy. The story on the front page of the *New York Times* began: "Human life may linger after the heart stops, and medical science has the right to struggle with all its means to bring a seemingly dead person back to life, Pope Pius said..."[73] Here, the Pope condoned the revival of an apparently dead body. In declaring brain death, the physician is faced with exactly the opposite problem: discontinuing life support of an apparently alive body in which the heart still beats despite a nonfunctional brain. The concept that life may linger after the heart stops, is also precisely the opposite case of brain death, where the Harvard Committee asserted that the heartbeat "lingers" after life "stops."

The Pope likewise made front page news in the *Boston Globe*, but Boston journalists lead with the opposite message: "Doctors may stop efforts to delay death... artificial methods of reviving life may be halted in order to allow a virtually dead patient to 'die in peace'."[74] The story stated that furthermore, although the Church was "not competent" to dictate the definition of death, "The doctors were told that they may remove respiration apparatus before blood circulation has definitely stopped," in response to a plea from the patient's family. In Boston as in New York, the physician's decision to continue life support was interpreted to be made only in the interest of the patient and family.

What was the epidemiological nature of intractable coma at the time? Before 1968, neither the numbers nor the experiences of particular patients generated any sensational concern. From the 1930s through the early 1960s, the news media infrequently reported cases of coma. When comatose persons made the news, journalists did not treat patients' prognoses and treatment as ethical dilemmas. Nor did they characterize coma as a special precedent to, or form of, death. Rather, information about coma was embedded in brief, "believe-it-or-not" style vignettes of the feats and fates of comatose individuals.[75] Typically, these stories commemorated the anniversary, miraculous recovery, or, least frequently, the death of a long-comatose patient. These remarkably long comas ranged from one month to nine years in duration. Patients were described by name, gender, age, occupation, and sometimes even their home addresses were printed. The cause of coma was typically noted, as was medical care and the patient's general health.

The comatose were imbued with a fictional liveliness through these stories, which focused more upon the patients' progress, health and growth than upon disability or dismal prognosis. Articles related how patients' hair, nails, and bodies grew during their confinement and what, if any, reactions and functions they were capable of. Patients were never portrayed as dead or questionably alive. Providers described their patients as "healthy" despite their predicaments, epitomized for example in the statement that, "although there was no indication that [the patient] would recover consciousness, his condition was described as fairly good."[76] The press related medicine's interpretation and management of the comatose state as bordering on the mystical. The cases uniformly baffled even expert physicians, who were sometimes quoted as deferring to God or miracles for help. However, even as medical understanding was admittedly poor, descriptions of state-of-the-art diagnostic and therapeutic technology gave the impression of committed and competent treatment. Patients were treated by "mystified" specialists with "fever machines," blood transfusions, serums, and blood "fluids," "shots of arrow poison used by South American Indians," ventriculograms, multiple unspecified "brain operations," feeding tubes, and oscillating beds.

The chronically comatose languished at medicine's frontier, where they were treated quite respectfully as either an amazing natural anomaly or a challenge to innovation. These coma stories did not presage concern about the comatose as dead or a social burden, and much less as a potential resource for transplantable tissues. Only one story recounted discontinuation of medical treatment in a hopeless case, in which the patient was discharged from the hospital alive to her family's care.[77] Cost of care was not mentioned and presumably not the reason for discharge. The problem of financing care emerged only in the case of Robert Steger of Cincinatti, an engineer who suffered a head injury in a 1943 industrial accident and was supported through his nine year coma by Workman's Compensation funds. His case was first reported in 1948, when he had suffered the longest period of unconsciousness in medical history, and the cost to the Ohio Industrial Commission for his care was reported to the last penny: $63,026.42.[78] Costs seemed interesting this case because they were so unusually high, and billed to public funds rather than family or charity resources. However, Steger's case remained isolated and neither he nor the issue became a topic of editorial concern.

Neither the chronically comatose nor the financing of hospital treatment reached a detectable public or professional crisis by 1968. The number of comatose may have been growing, but so was capacity of the system. The 1950s and 1960s were decades of great expansion in resources for health care. Private insurance covered increasing numbers of the population for any necessary treatment, demand and financing for medical research overwhelmed the supply of qualified physicians,[79] and federal insurance in the form of the new Medicare and Medicaid programs in the 1960s injected a flood of new dollars into the medical system. It is unlikely that Dr. Beecher's hypothetical 26 patients would have been denied treatment because a woman in a coma languished in one hospital bed. Although the

Committee invoked the expense of the hospitalized comatose in its justification of the redefinition of death, there is little historical evidence to suggest these issues themselves pressed for resolution in 1968.

Before 1968, there was very little popular or professional demand for the abandonment of hopeless patients in the interest of prudence. Rather, the bulk of popular and professional sentiment ran exactly the opposite: there was an irrationally strong demand for extremely costly and marginally effective treatments. Heart transplantation forms an ironic case in point. In terms of social resources, the early heart transplant recipients effectively replaced their brain dead organ donors in the precious ICU beds before following them to the grave. The celebrated first heart transplant patient, Louis Washkansky, lived only 18 days; the second recipient, an infant in New York, survived for only a few hours. Of the 100 heart transplants performed in the first year of the operation, only one patient survived longer than 11 months.[80] Heart transplant experiment subjects of the late 1960s also consumed lifesaving resources besides hospital beds. The transplant itself, not including aftercare, cost about $30,000. The first adult heart transplant in the United States consumed about 304 pints of blood, compared to the 20 or more pints typically required in severe cases of hemmorhage in childbirth, accidents, burns, or surgery.[81]

VII. Early Applications of the EEG to Coma and Death

EEG research itself did not by 1968 necessitate a reexamination of the nature death. Medical literature reveals little evidence that electroencephalographers had been bothered for years by flat brainwaves, and in 1968 decided something had to be done about it. The EEG of this time has been aptly described as "in search of a function;" researchers struggled to find both meaning in EEG readings and clinical applications for them.[82] However, they did not necessarily construct the EEG's functions in this logical order. Clinical applications produced meaning, as well as vice versa. Although EEG readings could be correlated with perplexing clinical observations, it often remained obscure to researchers precisely what internal processes the EEG transcribed. The function of the brain itself remained a black box, producing "waves" and behavior.

In the case of brain death, the EEG added meaning to the syndrome by making tangible the "absence" of an abstractly understood function. The absence of "brainwaves" could replace the traditionally recognized absence of "pulse" as the concrete sign of death. However, the concept of brain death also gave meaning to the flat EEG by equating it with the absence of clinically observable, useful personhood, and candidacy for vital organ donation. By the time the Harvard Committee deliberated the function of the EEG in the determination of death, the former role of the EEG would be subordinated to the latter. Whereas the EEG could provide useful "confirmation," a flat EEG alone did not necessarily indicate brain death. Further, brain death would be designed to be diagnosable without the aid of the EEG.

Two medical specialties, neurology and anesthesiology, applied the EEG to limited studies of the depths of unconsciousness. A promising function of the EEG which emerged in the 1950s was to guide anesthesiological assessment and management of patients during increasingly life-threatening surgical procedures.[83] However, the EEG turned out to have limited value for this purpose; readings varied among individuals, and interpretation was often ambiguous.[84] Through the 1950s and early 1960s, the EEG was seldom applied to the study of coma or death; one significant exception was the definition of "coma depassé" by French neurophysiologists in 1959.[85] The rarity of related published literature suggests that coma depassé and the study irreversible brain destruction did not much interest American researchers in the 1950s-1960s. Contemporary histories have described coma depassé as a nosological predecessor of "brain death," however there is no evidence that the Harvard Committee discussed or consulted the French research in their work. Other isolated applications of EEG to coma cases yielded inconclusive results. For example, a 1958 Italian study of the relationship between EEG patterns and depth of coma in 25 subjects concluded that "no definite relationships are found between depth of coma and type of electroencephalographic changes."[86]

Despite their disinterest in death, electroencephalographers in the mid-1960s anticipated a new professional role as consultant in questions of probable recovery, although certain prognoses were difficult. Bickford and colleagues in 1965 noted that, "increasingly the electroencephalographer is asked to give an opinion was to whether central nervous function is present or can be recovered;" and the difficulty of making these prognoses called for "pooling of experience" to decrease uncertainty and presumably increase the value and authority of the electroencephalographer's work.[87] Tentler and colleagues in 1957 published a report of a false positive diagnosis of death by EEG on a hypothermic surgical patient at a Veteran's Administration hospital.[88] Some of the EEG's early applications to deathlike states were motivated by the intention to revive the patient or control depth of unconsciousness rather than to confirm death. Electroencephalographers saw the potential to market their service as an empirically objective arbiter of moral authority, first to justify the medical preservation of life by detecting its subtlest presence in the body, and later in 1968 to confirm death when the determination of brain death became the clinical imperative. One physician wrote of the EEG's importance in verifying conventional death:

> The *sanctity of life* must not depend upon presence or absence of heart beat and respiration with brain function excluded when vital criteria are available through the electroencephalographer, *who should promote acceptance of his instrument and diagnostic skill* for legal certification of status mortis.[89]

Another paper demonstrated the ability of the EEG to disconfirm death in detecting brainwave activity despite the absence of heartbeat and breathing.[90] The EEG was even applied therapeutically rather than diagnostically in an attempt to salvage a failing life: in Spain, EEG electrodes were implanted in a terminally comatose patient with the intention of perhaps stimulating her to consciousness; readings were taken incidentally.[91]

The one research laboratory in the United States which pursued the relevance of the EEG to "death" was that at Massachusetts General Hospital in conjunction with Harvard Medical School. Hannibal Hamlin, the author cited above who advocated the use of the EEG to confirm life, also published an early version of Robert Schwab's criteria for brain death in 1964 (these criteria are included in Appendix 1).[92] Hamlin argued the equivalence of the flat EEG with death on the premise that, "[c]ertainly the human spirit that emerges in man's unique individuality is the product of his brain, not his heart."[93] He indicted life support of brain dead patients as violating "the nobility of death":

> If complete EEG silence could gain acceptance as proper grounds for withholding fruitless efforts at resuscitation, some of the nobility of death would be preserved where it has frequently been forfeited through our slavish and superstitious refusal to acknowledge that St. Peter is at the Gate or Charon at the Crossing.[94]

The terminology Massachusetts General researchers chose to describe the dead, as "viable" "heart-lung preparations," testified to the implications of the lab's new death definition for organ transplant research. Robert Schwab and his colleagues at Harvard had already applied the EEG to the diagnosis of death in 10 cases by 1963, and 15 cases by 1964.[95]

They described the following rationale for declaring death in the severely brain damaged, yet heart-beating, individual:

> The unfortunate situations, where the anoxia was so long that destruction to the respiratory centers and higher nervous system occurred, but where cardiac function was restored, are the subject of this report. In these cases a human heart-lung preparation results that may be viable for many days. For hundreds of years death was determined by the absence of a heart beat. Therefore the presence of a pulse, blood pressure, and audible heart beat makes it necessary to establish another indication of death.[96]

With this statement, Harvard's Electroencephalographic Laboratory bluntly suggested that the existence of a viable "heart-lung preparation" within a brain-destroyed body necessitated a redefinition of death. It is not known what became of the 10-15 cases Schwab diagnosed, whether they acted as actual "heart-lung preparations" for researchers, or whether perhaps the term simply reflected laboratory jargon and not clinical intentions.

VIII. The Popular Promotion of Organ Donation Before 1967

In the 1950s, the popular press had promoted the idea of cadaver tissue donation as a gift of life from medicine to the populace, in return for its discarded "spare parts": magazines introduced the topic with headlines such as "Spare Parts Bank" and "Spare Parts for People".[97] The "spare part" metaphor took hold in professional discourse as well. A 1964 primer on organ transplantation for both lay and professional audiences by Harvard physician Frances Moore described tissue transplantation as simply a speeded-up version of the natural "recycling" process by which the human body decomposes after death into elements which are then reorganized into life.[98] This bluntly implied that transplantation would simply be a more efficient approach to inevitable human composting.

Transplantation pragmatically took useless parts from dead bodies and gave them to patients who could really use them. In a remarkable inversion, the press depicted the potentially ghoulish process of removing such organs as a positive and invaluable act desired by the *useless dead person himself*. Medicine solicited tissue "donations" by convincing donors' next of kin that transplantation offered the dead a way to commit one last act of altruism, and thereby go on "living." A transcript of the telephone request for organ donation in 1955 employed such rhetoric as,

> We thought perhaps you might like John [the deceased] to help these others become whole and well again...a way, if you like, *for him to live by helping them*. For *him to do this*, we must have your permission...[99]

Permission wasn't requested for doctors to do something with the cadaver, but rather for the deceased himself to commit a miraculous act that grieving relatives could not justify denying him. Medicine hinted at the promise of perpetual life in two ways: the near dead would be rescued by another's virtuous gesture from beyond the grave. Paradoxically, such requests for donation appealed directly to the psychological denial of loss, which policymakers would subsequently blame for the public's reluctance to acknowledge brain death and retrieve organs - a problem that persists to this day.

Pressure for the public to donate tissue far preceded medicine's actual ability to deliver concrete benefits in return. In one breath, people were told tissue donation was morally imperative because it would save lives, and in the next they were warned not to expect transplantation to be available to them too soon. This double message effectively said that organ donation was demanded by medical science itself and called upon the public to sacrifice their spare parts as a sign of faith in the profession, in return for a promise of miracles to come. Ironically, this particular public relations angle may have contributed to a crisis of confidence in the profession's lifesaving motives. There was a basic inconsistency between the medical profession's movement to realistically give up in cases of terminal coma and the movement to press against the frontiers of death with ineffective but heroic efforts in cases of terminal organ failure.

Several medical authors in the late 1960s, besides the Harvard Committee, also cited the Pope's allocution as a precedent for either redefining death, or abandoning "heroic" treatment efforts in hopeless potential organ donors. However, the principle could not be pushed too far, as organ transplantation *itself* was a heroic, last ditch effort on behalf of an "hopeless" patient. If the patient were not so hopeless, then such invasive and dangerous experiments could not be justified ethically or legally. Transplantation and life support shared the same moral premises. If, according to the Pope, artificial, "extraordinary" lifesaving were not morally imperative, then experimental transplants might loose much of their moral force. Conversely, a populace cheering for heart transplantation against all odds could not possibly have been as enthusiastic about pragmatically pulling the plug of life support.

IX. Public Revelation of the Paradox: The Appearance of the Heart Donor

The media around the world celebrated the South African heart transplant in December of 1967 as a success, despite the patient's 18-day postoperative demise. The vast publicity focused unprecedented attention on the problem of vital organ donors. The donor was a young woman, Denise Darvall, who had been hit by a car. Press reports of Darvall's death conflicted. *Life* magazine reported that the removal of a beating heart would have constituted murder, and so "...the South African doctors waited until every sign of life... was gone, - not only in her heart but in her lungs and brain as well."[100] Marius Barnard told *Time* reporters,

> I know in some places they consider the patient dead when the electroencephalogram shows no more brain function. We are on the conservative side, and consider a patient dead when the heart is no longer working, the lungs are no longer working, and there are no longer any complexes on the ECG.[101]

In *Newsweek's* report, however, attending physicians seemed to obscure from public view the details of the donor's death. Questioned by reporters on the occasion, "...the surgeons would not say whether they took [the donor] off the respirator before her heart stopped. 'That's an impertinent question,' one of the surgeons [said]..."[102] The surgeons did admit that they did not attempt to resuscitate the woman once her heart had stopped, and that they disagreed among themselves about how dead the heart must be to justify its removal. Marius Barnard explained the conflict,

> 'I felt...we should take this heart in the best condition possible. Our responsibility was to the patient into whom we were going to transplant - not to this girl. But my brother [Christiaan] insisted that we wait.'[103]

"'You're dead when your doctor says you are'," *Newsweek* reporters concluded.[104] The press quickly perceived the new conceptual issues concerning the heart, the brain, death, and coma that the practice of heart transplantation revealed, and also grasped the ethical implications for patient welfare. Yet, reports of the specific medical criteria and policies for determining the heart donor's death remained confusingly ominous:

> ...on one score the ancients were right. The heart is essential to life in a more immediate, temporal sense than any other organ, even the brain. The human body can survive for years in a coma, with no conscious brain function - but only for minutes without a beating heart. So the presence of a heartbeat, along with breathing, has long been the basic criterion for distinguishing life from death. It still is, in the vast majority of cases, despite some special situations in which the brain's electrical activity is a more reliable index. (So far, no surgeon has seriously considered transplanting a brain, because, beyond the forbidding technical difficulties, this would be akin to transplanting a person...) ... The real moral and ethical difficulty in heart transplants arises from medical uncertainty... The surgeon wants the donor's heart as fresh as possible... - that is, within minutes of death. This has raised the specter of surgeons' becoming not only corpse snatchers but, even worse, of encouraging people to become corpses. The question remains: Where should the line be drawn between those to be resuscitated and those not to be?[105]

A 1968 survey of public attitudes toward the diagnosis of death revealed that the media coverage had influenced popular awareness of the issue of death. Sixty-nine percent of 112 people surveyed stated that they had "[given] thought to the issues of how death is determined;" however, only 9% "thought of death in terms of irreversible loss of cerebral function."[106] The crisis of confidence in doctors' motives grew out of the ironic contrast between the image of beating heart procurement with the popular portrayal of transplantation research as a grand gesture of medical benificence.

X. The Harvard Ad Hoc Committee: Negotiating a Redefinition of Death

Within one month of the first heart transplant, Harvard Medical School formed an "Ad Hoc Committee to Study the Problems of the Hopelessly Unconscious Patient," in response to an appeal to the medical school dean by Dr. Henry Beecher, a reputable Harvard anesthesiologist and ethicist. Before chairing the Ad Hoc Committee, Beecher had established himself as a formidable critic of the exploitation of patients as research subjects, and had written his famous1966 exposé of unethical practices published in the *New England Journal of Medicine.*[107] The article called attention to the high costs of clinical research, the career pressures encouraging experimentation, and the consequently common practice of experimenting on patients without obtaining adequate consent or protecting the subject/patient's health. Introducing this critique, Beecher criptically referred to concerns about "the recently added problems arising in the transplantation of organs," but he did not pursue this theme.[108]

The Harvard Committee completed its work in less than 6 months, by early June of the same year. The *Journal of the American Medical Association* in turn published the Committee's report almost immediately, on August 5, 1968. The paper, "A Definition of Irreversible Coma,"[109] contained a description of the clinical symptoms of irreversible coma, recommendations on organizational procedures for declaring death, legal commentary, and a concluding discussion of historical and moral justifications for new death criteria. In the published paper, the Harvard Committee described the impetus for its work as follows:

> Our primary purpose is to define irreversible coma as a new criterion for death. There are two reasons why there is need for a definition: (1) Improvements in resuscitative and supportive measures have led to increased efforts to save those who are desperately injured. Sometimes these efforts have only partial success so that the result is an individual whose heart continues to beat but whose brain is irreversibly damaged. The burden is great on patients who suffer permanent loss of intellect, on their families, on the hospitals, and on those in need of hospital beds already occupied by these comatose patients. (2) Obsolete criteria for the definition of death can lead to controversy in obtaining organs for transplantation.[110]

The following analysis of the Harvard Committee's work will examine the rhetoric addressing the given reasons for the definition: life support technology, burdens on the patient and others, and the controversial practice of organ procurement. This history will also examine how conflicting interests constructed an incomplete and problematic conception of brain death, evident for example in the Committee's strange suggestion above that the alleged "dead" are greatly burdened by their loss of intellect.

The membership of Harvard Committee was exclusive and elite by design, comprised of well acquainted colleagues to assure easy consensus.[111] The medical school Dean appointed the thirteen Committee members; senior faculty predominated. The group included ten physicians, one lawyer, one theologian, and one historian. The physicians' specialties included transplantation, anesthesiology, neurology, and psychiatry. Henry Beecher, Robert Schwab (a neuropsychiatrist and EEG pioneer), and William Curran (a lawyer with a background in public health and forensic science) primarily authored the manuscripts and final report, although they edited their work in response to guidance from the neurologists and transplant surgeons.

For the Harvard Committee members, transplantation was central to the purpose but detrimental to the rhetoric of redefining death. In constructing its definition, Committee members began with the necessary characteristics of vital organ donors, then strove to generalize these features to define irreversible coma, and finally death itself. However, the Committee had to make this essentially inductive reasoning process appear deductive, suggesting scientific legitimacy. Dean Ebert wrote in invitation to potential Committee members:

> Dr. Beecher's presentation [on the ethical problems created by the hopelessly unconscious man] re-emphasized to me the necessity of giving further consideration to the problem of brain death. With its pioneering interest in organ transplantation, I believe the faculty of the Harvard Medical School is better equipped to elucidate this area than any other single group.[112]

Harvard was uniquely qualified to define brain death not because of its experience with the irreversibly comatose per se, but with their usefulness to organ transplants.

A preliminary draft of the report opens with only a few lines of introduction, beginning,

> The primary obligation of this Committee is to define irreversible coma. If this can be done in satisfactory terms, translatable into action, several current problems will either disappear or will become much more readily soluble than is now the case.[113]

Later, in the draft's conclusion, the Harvard Committee explicates the centrality and nature of the organ transplantation problem:

> The question before this committee cannot be simply to define brain death. This would not advance the cause of organ transplantation since it would not cope with the essential issue of when the surgical team is authorized -- legally, morally, and medically -- in removing a vital organ...[114]

The need for organs guided the Committee's discussion. A preliminary report draft outlined "four major questions," complete with "'answers'... for the Committee to shoot at during [their next] meeting":

> 1. Under what circumstances, if ever, shall extraordinary means of support be terminated, with death to follow? (Answer: When the criteria of irreversible coma described above have been fulfilled.)
>
> 2. From the earliest times the moment of death has been recognized as the time the heart beat ceased. Is there adequate evidence now that the "moment of death" should be advanced to coincide with irreversible coma while the heart continues to beat? (Answer: Yes.)
>
> 3. When, if ever, and under what circumstances is it right to use for transplantation the tissues and organs of a hopelessly unconscious patient? (Answer: When the criteria of irreversible coma described above have been fulfilled.)
>
> 4. Can society afford to discard the tissues and organs of the hopelessly unconscious patient when they could be used to restore the otherwise hopelessly ill but still salvageable individual? (Answer: No.)[115]

The Committee's work was guided by answers, not questions. Their task would be to rationalize and sanction vital organ removal.

In the spirit of its mission to "advance the cause of organ transplantation," the final draft gave as one of two reasons for defining irreversible coma:

> With increased experience and knowledge and development in the field of transplantation, there is great need for the tissues and organs of the hopelessly comatose in order to restore to health those who are still salvageable.[116]

This statement belied the absolute necessity of the brain dead to new transplantation technology, to the degree that one Committee member cautioned against the use of such wording:

> [The statement] would tend to suggest, as written, that the need is for tissues and organs only of hopelessly comatose individuals. I realize what you mean is that the hopelessly comatose, among others, are possible organ donors.[117]

In the case of nonvital organs such as kidneys, this would have been true. For heart transplantation, however, the brain dead were the only organ source. The Dean reacted more strongly to the former statement, writing to the Committee Chair that,

> The connotation of this statement is unfortunate, for it suggests that you wish to redefine death in order to make organs more readily available to persons requiring transplants. Immediately the reader thinks how this principle might be abused.... Would it not be better to state the problem, and indicate that obsolete criteria for the definition of death can lead to controversy in obtaining organs for transplantation?[118]

The published report incorporated the Dean's words, representing death criteria as obsolete *a priori* to the new demands of heart transplant technology.

The impetus for the redefinition of death was fueled in part by the relatively mysterious EEG technology's "search for a function" in its investigational years.[119] Some of impetus for the Harvard Ad Hoc Committee of 1968 came from the EEG laboratory at Massachusetts General Hospital; its director, Robert Schwab, became one of three dominant authors of the committee's report.[120] Traditionally, the presence of a pulse has signified a living heart, and its absence the onset of death. Similarly, the Harvard Committee sought an analogous rhythmic pulse of brain activity by which to detect the moment of death. At the outset of its work, the group believed it would find just such a signal in EEG readings. However, the Committee - with medicine in general - struggled with the problem that despite its comforting concreteness, the EEG sign did not relate perfectly to physiological knowledge, nor to the new beliefs about the nature of death. Organ transplantation interests intervened in the EEG's own "imperative" to dictate a final definition of death which yielded the EEG a scientifically marginal but clinically substantial role.

EEG research did not make a substantial or necessary scientific contribution to the brain death debate. The imperative apparently worked in the opposite direction: electroencephalographers recognized that brain death could make a contribution to the clinical viability of the EEG. Schwab's early proposal and later the Harvard Committee statement created a new demand for EEG services. The Harvard Committee, initially optimistic that the EEG would play a central role in validating their criteria,[121] eventually became reluctant to rely explicitly on the technology. Only about one third of U.S. hospitals had EEG machines in 1968; requiring a flat EEG to confirm death would have meant that hospitals without EEGs would not be able to supply organ donors.[122] Whereas brain death offered an opportunity for the EEG to enter more hospitals, transplant surgeons did not want to be held back while waiting for this diffusion. The Harvard Committee artfully negotiated between the interests of transplantation and the EEG, and produced a policy which would maximize the use of both technologies without tying one's utility to the other: the EEG was to be applied for verification wherever available, but the diagnosis of brain death (and procurement of organs) could be made reliably without it,

> The Committee was unanimous in their belief that an electroencephalogram was not essential to a diagnosis of irreversible coma, but it was the view that when dependably available it could provide valuable supporting data.[123]

Even after the EEG had failed to deliver the promised scientific fortification with which it gained entry into the redefinition of death, the technology retained a foothold in its new clinical territory. After the 1968 Harvard criteria were established, one electroencephalographer promoted the value of EEG readings for the legal documentation of ethical behavior in a brain death diagnosis when"...the obligation to graft 'healthy' organs requires a diagnosis of death to be established with the least possible delay..." and when, "a formal diagnosis of irreversible coma has to be made in a restricted time in order to authorize the removal of organs from a young trauma case..."[124]

Although medicine sought diagnostic technology to provide objective measurements, the instruments were chosen or rejected according to their ability to confirm a conceptual category already established on an intuitive and moral level. Brain death was the *a priori* conclusion, the EEG was useful inasfar as it could legitimate this conclusion with timely empirical evidence. The EEG did surprisingly little to reveal brain death, while brain death did surprisingly much for the career of the EEG.

Regarding the question of who in society rightfully *should* redefine brain death and determine the fate of the hopelessly comatose, Ralph Potter wrote during his tenure on the Committee,

> It is difficult to claim that any particular discipline or segment of society has a special competence to settle such an issue [of how the irreversibly comatose should be treated]. It is a question for the public... We should try to be self-conscious in our espousal of moral values and be willing to explicate the reasons for our conclusions without pretending that they flow directly from technical competence in a discipline beyond the grasp of the uninitiated... These are human questions. Expertise in such matters is not conveyed automatically though the curriculum of a medical school, a law school, nor, I fear, a divinity school.[125]

However, the Harvard Committee's founders did not believe this was "a question for the public." On the contrary, they actively strove to protect the debate from the capriciousness of public venue. The Committee's timing, goals, and work strategically expropriated the question from a host of increasingly interested outside parties who would not be expected to keep the interests of transplantation as close at heart, among them the news media, the courts, and professional organizations such as the American EEG Society.

The dean, transplant surgeon Murray, and attorney Curran pressed Beecher and the rest of the Committee to work quickly. A timely statement would not only ward off legal problems with transplantation, but equally importantly, would preempt competing groups' potential claims to authority if Harvard could produce its statement first. William Curran wrote to the dean and colleagues on the Committee to urge speed because of "the many other groups interest in the field" and his personal concern "...with the possibilities of unfortunate and perhaps even dangerous legal action which may be taken if responsible groups do not report within a reasonable time and thus provide grounds for effective action."[126] In March, Beecher responded to the dean that he was "grateful" for the "keen interest in this area" but that,

> ...it would be nothing short of disastrous for us to rush our considerations simply because other groups may be plowing the same field. The matters under consideration are so delicate and could so easily be misunderstood, I think we shall have to move like the Supreme Court, with all deliberate speed - but not faster![127]

The pace of the project revealed the urgency of both of Harvard's problems of legitimately procuring vital organs and retaining authority in the field. However, the urgency was not on account of the clinical problem of the "hopelessly unconscious patient," who by 1968 had compatibly occupied the medical world for many years.

To accommodate the practice of transplantation, the Committee not only had to be expeditious in their own work, but also had to establish a protocol that would allow speedy diagnosis of death and removal of "fresher" organs in each case. An early draft of the report recommended that the signs of death be reaffirmed at 24 hour intervals for three days before life support is terminated. This policy was met with dismay by transplant surgeon Joseph Murray, who wrote in the margin of the manuscript, "Does this mean we must wait 72 hours?!"[128] The Committee eventually settled on a single 24 hour period for verification. The waiting time has eroded further in protocols subsequent to the Harvard criteria, to 12 hours, or even left unspecified in some cases.[129,130] Ironically, Harvard's "long" waiting period of 24 hours compared to contemporary criteria has been interpreted historically as evidence that the Harvard Committee was relatively unconcerned with organ transplantation:

> The twenty-four hour delay is explained by the fact that the Harvard criteria were designed with the question in mind of when to shut off the ventilator without consideration of the question of organ transplantation.[131]
>
> The Harvard criteria are based upon experience with terminally ill patients without consideration of organ transplantation... There was no urgency to obtain viable organs. Thus a 24-hour delay for re-evaluation propounded no problem.[132]

The Harvard Committee took care that their new criteria for death did not appear to emerge primarily out of elite professional interests in organs. The definition itself incorporated a related concern that doctors applying the criteria *at the bedside* be protected from any appearance of a conflict of interest. To this end, a significant amount of the Committee's intercommunication concerned the institutional protocols for declaring death and discontinuing life support. Even once the clinical moment of death was described, several organizational issues remained: who should declare death, when should the respirator be turned off, how should the family be involved, and how should the transplant team be involved?

First, should a physician alone declare brain death? An early draft of the report included a section entitled "Additional Safeguards for the Doctor in Charge," which offered the following advice: "Inform the family. Share the responsibility for turning off the respirator with one or more colleagues. Inform all special nurses as well as floor nurses."[133] This language was eventually rejected on the grounds that it made the declaration of death appear too uncertain; prior to 1968, physicians did not normally "share the responsibility" or warn colleagues that a death declaration was imminent. Despite their impulse thus to treat brain death as a medically controversial procedure, the Harvard Committee eventually rejected such precautions because they too explicitly suggested diagnostic insecurity and impure intentions among physicians.

Another issue was whether to prohibit physicians involved in transplantation from diagnosing death in the case of a potential organ donor. For example, one Committee member suggested that at most only one member of the team caring for the comatose patient be made aware that someone else awaited a transplant. However the Harvard Committee again resisted the urge to characterize brain death as controversial by barring certain interested physicians from the scene. The Committee hoped that their specification of objective criteria would leave little latitude for diagnostic discretion, regardless of the physician's specialty and or ulterior motives.[134] Interestingly, while medicine promoted the power of rational criteria over utilitarian interests to ensure ethical behavior, these "objective" medical criteria have not sufficed since 1968 in the legislative arena. State laws concerning the legality of brain death, including the Uniform Anatomical Gift Act, have incorporated requirements that more than one physician declare death and prohibited transplant surgeons from involvement.[135]

Although legislation would soon bar transplant surgeons from clinically diagnosing the death of a potential organ donor, these same physicians substantially formed the clinical criteria other doctors would apply. Transplant surgeons' involvement in the determination of the signs of death, in contrast to their involvement of the determination of death in individual cases, was not seen by the Harvard Medical School as a conflict of interest but rather as essential to the work. For the technology of heart transplantation to progress, the Harvard Committee had to define death to the satisfaction of transplant surgeons.

The overriding goal of the Committee was to obtain license for physicians to stop life support, halt heart function, and dispose of the body and organs in ways they deemed most medically and socially beneficial. Although the Harvard Committee members agreed on their overall mission, they disagreed over their immediate strategic objectives. A major point of debate was whether the Committee was redefining "death" per se, or simply defining "irreversible coma." Need a patient be declared "dead" or merely "hopeless" to justify their involuntary organ "donation"?

Murray, a transplant surgeon, protested the Committee's originally stated goal of describing "irreversible coma." He edited report drafts to substitute "death" for "irreversible coma," and further objected to the qualification "brain" in "brain death".[136] He wrote to Beecher,

> The term 'brain death' should be eliminated. Death is what we are talking about, and adding the adjective 'brain' implies some restriction on the term as if it were an incomplete type of death. 'Irreversible coma,' a term suggested by Dr. Schwab, might be a synonym for death. About that I will not quarrel. However, our charge is to define death in terms that are acceptable to the medical profession.[137]

Neurologist Derek Denny-Brown considered the criterion of irreversibility not specific enough and difficult to diagnose in the case of coma. He wrote to Beecher in response to an early draft of the report,

> The legal situation is interesting, but does not help resolve what appears to me to be primarily a clinical medical question. One has to set aside questions of prognosis for recovery of intellectual function, testamentary capacity, etc. as being irrelevant to the question of life and death, and in any case not resolvable during the presence of coma.[138]

In this memo he also recounted two patients in his experience who recovered after 5 to 11 months of "complete unresponsiveness, as well as more responsive cases of basilar artery syndrome who "do not ultimately recover."

In direct opposition to Murray's approach, the EEG specialist Robert Schwab edited the manuscript to change every instance of "brain death" to "irreversible coma," noting:

> It is not necessary to change definition of death or to define Brain Death. If we establish the concept of irreversible coma with cessation of function at all levels of the CNS [central nervous system], it will not be difficult for those in charge...to withhold or discontinue mechanical, electrical, or pharmacological aids which then is followed in a minute or two by cessation of the pulse and this is the moment of death.[139]

Committee theologian and ethicist Ralph Potter articulated a more political rationale behind defining "death" rather than "irreversible coma" for the purposes of disposing of the body: if irreversible coma were promoted as a sufficient (but not a necessary) reason to discontinue life support, physicians might act inconsistently and thereby attract public attention and possibly lay interference:

> If physicians cannot agree in theory and practice on when supporting measures are to be withdrawn, they are likely to forfeit the responsibility and prerogative of delivering a virtually unchallenged declaration of death.[140]

Potter recommended instead an alternative approach. By redefining "death" per se, medicine would be most likely to reserve autonomy to manage the irreversibly comatose. This strategy would,

> ...preserv[e] the simplicity and rigor of the principle by redefining the boundaries of life and death in a manner calculated to exclude many of those in irreversible coma from the category of the living. It thus becomes possible to say: 'Surely, if someone is alive we have an obligation to sustain his life by all possible means. But those who sink into an irreversible coma are not to be considered alive.' [This] approach is characterized by the attempt to redefine 'death'...[141]

The Harvard Committee ultimately favored this tack. The group changed their own title from "The Ad Hoc Committee to Study the Problems of the Hopelessly Unconscious Patient" to "The Ad Hoc Committee to Examine the Definition of Brain Death" by the completion of their work.[142] The language in their published report diplomatically alternated between the terms "irreversible coma" and "brain death" to effect both a redefinition of death and synonymity of the terms.

One of the most remarkable features of the Committee's work is how little it relied upon published empirical studies or conventionally scientific evidence. Dr. Beecher was well known for his promotion of ethics and empirical validity in human research, and yet he offered his medical colleagues no empirical support for the diagnostic criteria for brain death in the Harvard Committee's published report. Although highly unusual in an academic forum, the only citation in the paper was to a statement by Pope Pius XII.

The omission of citations did not reflect a dearth of academic work on the subject. In fact, some committee members themselves had previously published relevant work. Schwab and his colleagues had written on the use of EEG for death determination as early as 1963, and in 1966 Joseph Murray had presented a paper to the Ciba symposium, where brain death had been discussed energetically by himself and others.[143] Organ procurement had been addressed generally as an "ethical problem" in both medical and legal literature; some of these pieces touched on the problem of brain death. Francis Moore, himself a Harvard transplant surgeon, had raised the question in his 1964 book.[144] An even greater number of related works addressing brain death were published almost simultaneously in 1968, yet Harvard gave no formal sign of recognition of, much less collaboration, with colleagues' research. Even three references appearing in an early draft of the Committee's report were omitted from the final paper.[145]

It is not clear why the Harvard Committee did not acknowledge the academic literature or contemporaneous activity on the problem. However, it is possible that a conventional literature review may have undermined, rather than fortified, the authority of its statement. Many existing analyses had presented brain death as an "issue." The Committee's purpose was to recreate brain death as a medically verifiable "fact." This was accomplished largely by constructing the technical presence of brain death, not by resolving all the philosophical problems embedded in the "issue." References to earlier literature might have invited readers to dredge up questions that had been quite painstakingly and neatly buried in the technical criteria. Also, in many of the available works conspicuously related death redefinition to the needs of organ transplantation. Part of the Committee's goal was to derive a concept that would appear pure of opportunistic intentions. Worse, some of these sources (such as the Ciba transcripts) suggested that the diagnosis of brain death was already an established clinical practice in some places. Harvard's report gave the opposite impression: that contrary to fears following the suggestive reports of the first heart transplants, medicine had not put the cart before the horse in this very sensitive area and begun taking organs from questionably dead patients without due scientific and philosophical understanding.

Correspondence and manuscripts of the Harvard Committee reveal that it did consider some empirical evidence, especially regarding the applicability of the EEG. This research suggested that diagnosis of coma irreversibility was slightly fallible. None of the considered evidence had been peer reviewed or published, which perhaps explains its omission from the Committee's own published report. Early manuscripts include citations of unpublished studies by Schwab and his colleagues on experience with EEG in determination of death. Perhaps the most important document considered was a preliminary study by the American EEG Society on the Problem of Cerebral Death, supplied under the protection of utmost confidentiality to Dr. Beecher by Dr. Schwab (who was a member of both the Harvard Committee and the EEG Society). The EEG Society's paper analyzed 30 unpublished reports of 600 cases of flat EEG, and found five recoveries. These recovered cases would have been ruled out by the Harvard Committee's final criteria of no respiration, reflexes, nervous system depressants, or hypothermia in addition to the flat EEG.

The Committee self-consciously crafted its report as an historical event, its historiographic perspective biased by distinctly futuristic visions. To be accepted in a medical world identified with technological improvement, brain death needed to be characterized as intrinsically progressive. A historical gaze naturalized the Committee's work by situating it upon precedent, as well as by portraying it as part of an inevitable revolution of modernity. George Williams, Dean Ebert's original choice for Committee's theologian, wrote in declining the invitation that his orientation was too conventionally historical:

> ...it would be much better to have on your committee from the Divinity School, not a Church historian who instinctively looks to the past, but rather a professional ethicist... the man representing theology and ethics on your medical committee should be one primarily oriented to the present and the future.[146]

The Harvard historian of science, Everett Mendelsohn, participated in the committee. The June 3 draft of the report included the historiographic comment:

> From ancient times down to the recent past it was perfectly clear that when the respiration and heart stopped, the brain would die in a few minutes; so the obvious criterion of no heart beat as synonymous with death was accurate enough. This is no longer the case when modern resuscitative and supportive measures are involved.[147]

Mendelsohn wrote to Beecher in response to the draft:

> ...[regarding the historical remark in the report] what is really interesting, I suspect, is that the organ chosen -- the heart -- as the symbol for whether or not life exists, directly reflects the physiology of the time which indicated the heart to be the central organ of the body. One very real reason for turning to the brain today is our recognition of functions which the brain carries out which were not realized in anything like the same fashion at earlier periods of history. We might almost say then that we want to bring our definition of death into line with modern physiology.[148]

In the published report, the Committee incorporated the spirit of Mendelsohn's remark to depict heart-based criteria as a relic of primitive culture: "In those [ancient] times the heart was considered to be the central organ of the body; it is not surprising that its failure marked the onset of death. This is no longer valid when modern resuscitative and supportive measures are used."[149] The idea of the brain as the "new" central organ was implicit.

XI. Discussion

Four years after the Harvard Ad Hoc Committee's statement on brain death and the entrenchment of the technology of heart transplantation, an updated edition of Francis Moore's book implied that critical conceptual progress had been made:

> There was a remarkable change in concept and public understanding during the years 1966, 1967, and 1968. These were years during which most scientists came to agree that the personal and social meaning of the word 'death' applied to irreversible brain death regardless of the state of other tissues and organs. Public accommodation to this concept seemed almost immediate.[150]

Moore's rosy vision of consensus conflicts with all available evidence. Scientists (much less other philosophers) did not agree - indeed have not *yet* agreed - on the "personal and social meaning of death." Public accommodation, measured both in terms of citizens' willingness to bequeath organs, and health professionals' willingness to diagnose brain death, has also not occurred on a large scale. This very lack of consensus and conceptual sophistication is belied by Moore's own qualification of the term "brain death" with "irreversible."

In fact, brain death since 1968 has gained slow and reluctant acceptance in American "society." Even today there remains wide professional and public resistance to the declaration of brain death and removal of vital organs.[151] Of the 75% of Americans who approve of the idea of organ donation, only 17% have signed donor cards, and only about 8% have notified their families of their wishes, two steps important to ensure posthumous donation.[152] A 1985 Gallup poll of public attitudes towards organ donation determined the three leading reasons for this reluctance to be: 1) "They might do something to me before I am really dead"; 2) "Doctors might hasten my death"; and, 3) "I don't like to think about dying".[153] A survey of physicians from 1968 through the mid-1970s found that nearly 30% would have chosen to leave the respirator running on a brain dead patient. Only 13% of neurosurgeons and 2% of internal medicine specialists would have discontinued artificial respiration of a brain dead patient without consultation; 8% of pediatricians would even have chosen to resuscitate an anencephalic infant (who is not only brain dead, but has no brain to constitute "life").[154]

The term "brain death," or its clinical synonyms, "coma depassé" and "irreversible coma," did not appear in standard medical dictionaries for over a decade.[155] Indeed, ten years after the Harvard Committee's work, a 1978 dictionary did not include "brain death" among its nineteen variations on the term "death" (despite the inclusion of such obscure death forms as "red death" and "thymineless death").[156] Similarly, "brain death" did not appear in a standard diagnosis and treatment manual until as late as 1985, and even then its description began with the caveat that, "The definition of brain death is controversial, and diagnostic criteria have been published by many different professional organizations."[157] Was the definition of brain death, then, a conceptual failure? Was medical autonomy vanguished by ethical and cultural forces incompatible with the transplant ethos?

The impact of the brain death definition is characterized by formal acceptance and informal resistance. After 1968, the redefinition of death became a popular academic enterprise for medical elites and professional ethicists. More importantly, through the 1970s, most American states adopted statutes which sanctioned medical authority over death criteria, the concept of "brain death" in particular, and the removal of organs for transplants.[158] Although brain death did not "take" throughout society, its codification in medical literature and legislation was critical to elite physicians in selected cases. The redefinition of death by committee did not result in the wholesale life support "plug pulling" of brain dead cases, nor full exploitation of the potential supply of organs. However, what the partial, and especially legislative, acceptance of brain death did allow was the progress of transplant research. While the creation of "brain death" itself has not ensured a supply of organs, it has supported research necessary for the institutionalization of the technology of organ transplantation. Subsequent social investment in transplantation has consequently entitled the medical profession to complain of a deadly organ "shortage."

Physicians need not declare brain death, and some choose not to. However, this phenomenon does not necessarily signify a failure of the redefinition of death, but rather the cost of its *deliberately* retained medical discretion. On the one hand, transplant advocates packaged brain death as a concrete "fact," with clear measurable boundaries. Thus technically supported, physicians declaring brain death would not err as they might if relying on more "fuzzy" cultural criteria such as loss of socially meaningful existence. While the technical boundaries of the brain death category were designed to be inviolable by popular doubt, they remained by design permeable to physician discretion. Brain death at in its inception in 1968 was an airtight category only for the purpose of exonerating transplant researchers taking organs. The elite professionals who redefined death sought a new domain of clinical discretion, based on rational standardized reasoning, but without inviting the interference of prescriptive protocol.

The definition of brain death did not *compel* physicians to identify the terminally comatose and declare them dead; it *allowed* them to. Physicians, and not patients, were afforded new rights through the redefinition of death. With the help of the physician, dead persons might be allowed to make themselves useful, and might be allowed final liberation from their "living corpse." The dead could not, however, prevail upon physicians to grant these favors; indeed, physicians were left medically justified in applying whatever ethical or spiritual interpretation of death and dying they chose. To this day, penetrating professional debates continue on the moment of death and the meaning of irreversible coma. Yet, this lack of professional consensus does not interfere with either those physicians who choose to practice organ procurement from the brain dead, or those who choose to await conventional death of the "brain dead" on life support. The concept of brain death "took" only where it mattered most, to the professionally elite interests involved in the redefinition.

To return to the themes of brain death historiography discussed in the introduction to this analysis: it certainly was not coincidental that the first heart transplant was followed within 6 months by a new definition of death, formulated with the guidance of transplant surgeons, that would classify potential heart donors as "dead." Heart transplantation compelled Harvard Medical School to fashion a popularly recognizable historical moment by tying the formerly disparate threads of social values, medical technologies, and comatose bodies into the conceptual "knot" of brain death. Proponents of brain death have portrayed the redefinition process as a natural, progressive response to several coincident technological advances. Such historical glances assume that social accommodation to technological progress is pristinely rational and thus inherently virtuous, ignoring the existence of competing interests and the troubled negotiations they brought to the formation of an apparently objective clinical description. This historiographic gaze was established in 1968 by the Harvard Committee itself, and has been perpetuated especially enthusiastically by contemporary authors who wish to broaden the definition of death further to include more patients with less brain damage.[159]

Evidence remaining from the Harvard Committee's work reveals that the Committee undeniably responded to a new threat of outside scrutiny, as Rothman has noted. On a macro level, the Committee's existence, composition, and mandate suggest that the medical profession indeed experienced unwelcome interference. Nevertheless, a micro analysis of the actual definition process reveals that medicine retained significant authority to define death according to its own utility. The intracommittee discourse which created brain death reveals a struggle for legitimacy between professional factions, as well as between professional and popular culture. The Committee used rhetoric to translate critical social questions into technical issues. A breakdown of conventional logic and confusion of values appeared as policymakers tried to create a new language for death and its novel relationship to transplantation; the legacy of this ongoing struggle has been a literature full of problematic terms such as "the brain-dead-ex-person" and "organ harvest".[160]

The alternative history here has revisited brain death's inception, to locate points of debate and discover the political struggles behind them. From this perspective, brain death appears as a crisis point in medical culture where technical goals partially displaced a traditional social mandate. Brain death also emerges as a strategic triumph of elite medical interests. However, the technological imperative model does not obsolesce with the discovery of these social influences. Rather, placing the Harvard Committee's negotiating table in the conventional landscape of marvelous machines creates a more complete picture in which to trace the influences between men and their technics.[161] What might the history of brain death contribute to theory about "technological imperatives" in medicine of the late 1960s?

Theories of Technological Imperatives

Diverse theories of the function of "technology" in society have emerged in recent decades from the disciplines of philosophy, sociology, anthropology, and political science. The use of the term "technological imperative" in policy discussions typically plays a normative role: either it refers to the irrationally expensive adoption of "whatever is coming down the pike," or it refers to a healthy social accommodation to "progress".[162] In more academic treatments, technology is typically understood in one of three ways. First, is may be seen as as a "tool," controlled entirely by deliberate human action. The NRA slogan, "guns don't kill, people do," epitomizes the view. A second alternative view shows the influence in reverse: technology works "autonomously," robotically dictating human activity. The popular maxim, "if all you have is a hammer, all problems look like nails" illustrates this perspective.

Finally, a third more holistic perspective places technology in a matrix of social relationships, where the influence is not unidirectional but reciprocal between social interests and technological demands. This complex and not neatly coherent body of theory defies aphorism. Various metaphors from other disciplines have been invoked to describe a more symbiotic relationship between technology and society, characteristically portrayed as organic or strategic in nature. Biological perspectives see technology as following a typical "life cycle" or "career".[163] Ecological perspectives model technology as adaptive and subject to environmental selection.[164] Economic perspectives treat technology as a marketable commodity or "production function"; political economy perspectives may adhere to classic Marxist technological determinism, or see technology as strategy for capitalist market differentiation.[165] Organizational theory allows technology to be seen as an institution, while political science has characterized technology as literally "legislating" political agendas.[166] More anthropological "constructivist" models reveals technology as possessing social position which is socially constructed and in turn exerts some influence on the construction of other categories occupied by both persons and other technologies.[167]

For historiographic purposes, it is important to note about social theories of technological imperatives that the location of the imperative, or the "power of technology," is in part a function of the thinker's discipline and own activist agenda. Consequently these theories serve various normative beliefs about what the power of technology *should* be, beyond what it is. It is also likely a historiographic fallacy to assume that the nature of the technological imperative is constant through history. The meaning of technology, and its attendant relationship to human imagination and activity, changes through time. In particular, the 1960s may represent the apex of American faith in the promise and power of the machine; since then we have become more sophisticatedly skeptical about technology. In fact, much of the recent scrutiny of the concept of the "technological imperative" has been developed in an effort to cope with this disillusionment.

This said, I propose that the themes in this history of brain death resonate with three contemporary theories of technological imperatives. First, in the tradition of the "autonomous technology" model, brain death may be understood as part of a larger process of "reverse adaptation" of social values to medical technology. The social category of brain death was created by the demands of a technological system so complex that it had grown beyond leveraged, conscious control by any willful person. Second, more reciprocal models of technological influence help to explain the paradox of professional success despite popular failure of the concept. "Life cycle" models of technology instruct that the diffusion of a medical treatment depends not so much upon its objective "effectiveness," as upon professional investments in its development and promise. The concept of brain death, even narrowly applied, allowed transplantation to become institutionalized as an acceptable practice. Finally, technology may be understood as "legislating," a conceptual marriage between the "autonomous" and "institutionalized" characters of technology. The technical features of transplantation allowed the medicalization (and thus control) of social activities which might otherwise have been orchestrated by politics, law, or popular culture.

Medical Technology and the "Legislation" of Brain Death

It does not suffice to dismiss an historical moment with the explanation "technology made them do it." Technology does seem to be an autonomous force in history, but specifically *how* does it act? Langdon Winner's concept of "reverse adaptation" in socio-technical systems provides a useful framework for understanding the technological context of the brain death definition. Reverse adaptation refers to the tendency for established technological systems to orient toward technical, rather than social, goals. Compelling technical requirements may develop irrespective of, and even in conflict with, the original functional purpose of the technology. Winner describes the phenomenon:

> In the original design, all technologies are purposive... [however] in some cases, the originally established end of a system may turn out to be a restraint upon the system's ability to grow or operate properly...a system may well find it necessary to junk the whole end-means logic and take a different course. It may decide to take direct action to extend its control over the ends themselves. After all, when strongly asserted needs, purposes, or goals begin to pose a risk to the system's effective operation, why not choose transcendence? Why not treat the ends as an 'input' like any other, include them in the plan, and tailor them to the system's *own needs*?[168]

Winner outlines the salient patterns of technological "reverse adaptation" as follows:

1. The system controls markets relevant to its operations.
2. The system propagates or manipulates the needs it also serves.
3. The system discovers or creates a crisis to justify its own further expansion...Two scenarios of this sort have become familiar in recent years: the threat and the shortage.
4. The system controls or strongly influences the political processes that ostensibly regulate its output and operating conditions.
5. The system seeks a 'mission' to match its technological capabilities.[169]

These patterns are remarkably evident in the development of brain death criteria in tandem with heart transplantation in the late 1960s. The most important concept is that of the technological "system," distinct from the technologies themselves. Individual technologies - the EEG, the respirator, and heart transplantation - each brought a special agenda to the table where the definition of death was renegotiated. In a sense, the clinical definition of brain death constituted a contract, which accorded each technological interest certain roles, responsibilities, and rewards. Yet superimposed over the unique story of each technology is the story of Technology with a capital "T": a systematic ideology in medicine. As a holistic system, technology of the late 1960s compelled powerful and paradoxical agendas of its own.

Emerging procedures intervened as much in other technologies as they did in patients' health. Many developments arose to deal with the iatrogenic consequences of existing or even distantly anticipated procedures. With the introduction of the ICU, the hospital became a place where patients in exceptionally bad shape could be maintained and restored; physicians were able to take advantage of this feature of their "workshop" by pursuing ever more dangerous, "heroic" interventions while at the same time improving on the backup features of the workshop. Diagnostic techniques branched into the function of monitoring. Electroencephalographers investigated coma in part to help anesthesiologists control the effects of powerful new anesthetics. These new anesthetics in turn allowed more time consuming and thus complicated surgical procedures, such as open heart surgery. The respirator allowed surgeons to open the chest cavity without collapsing the lungs and asphyxiating the patient; later the respirator allowed providers to maintain "brain dead" bodies as chronic ICU customers or sources of transplantable organs. Ambitious new surgical innovations resulted in more extreme iatrogenesis, which in turn redoubled physicians' ethical commitment to sustain the half dead casualties of medical experimentation on state of the art life support.

Essentially many of the same therapeutic motives and technological methods that created heart transplantation created the brain dead. The famous pioneer of cardiac surgery, Denton Cooley perhaps unwittingly anticipated medicine's redefinition of death, when he joked in the early days of open heart surgery that postoperative pediatric patients should be assigned to one of three categories for follow up: "alive, dead, and 'other'"[170] Heart transplantation policy in fact was related to expectations about the future viability of radical new procedures such as coronary artery bypass and the artificial heart. Transplantation would be relied upon as a backup to rescue patients from early experimental failures of both of these anticipated innovations.

In the 1960s, a pervasive expectation grew that technology would replace, rather than restore, failing human functions: anything was possible. The artificial kidney and research into artificial hearts drove this new wave of technological venture. The television show, "The Six Million Dollar Man," epitomized popular expectations. Some regarded ineffective heart transplantation as a "halfway" technology which would eventually be supplanted not by the perfected heart transplant, but by the perfected artificial heart. The popular imagination expected advanced medical technology to serve as insurance against the most fundamental human uncertainties of aging and death, circumventing the natural fallibility of the body. Medical technology was valued as much as a concept, for its future possibilities, as for the demonstrable benefits of existing techniques.

The relevant "markets" over which technological interests gained control included not only an excess demand for medical care and and expanding supply of resources such as funding and equipment, but the new supply and demand of a more critical resource: human organs. The "crises" relevant to this history are still familiar today: the threat of disease coupled with the persistent "shortage" of transplantable organs and apparent shortage of health care resources in general. With regard to the latter, the medical profession had little reason to object to the use of medical resources; health care was, after all, its livelihood and an expanding market. It was only in 1968, when comatose bodies not only used resources but themselves *became* medical resources, that there emerged an almost frantic interest in the production and control of this commodity. The "control of political processes" is evident in the Harvard medical faculty's successful cooptation of public, legal, and outside medical concern over the practices of life support and organ procurement.

A fundamental symptoms of reverse adaptation in the definition of brain death was the essentially unscientific pursuit of foregone conclusions in the Committee's investigations. The Committee's *a priori* belief in the existence of brain death grew from professional commitments to medical technologies and their interests. The Committee selectively pursued arguments which would confirm their intuitions and meet pressing practical needs; they neglected questions and evidence that might have undermined either the cause of heart transplantation or the their own privilege to redefine death.

The adjustment of "mission" to accommodate technological capacity is the key irony in this history. Since the Enlightenment, certainty of the death diagnosis, as well as the therapeutic challenge of death, had earned the medical profession growing social esteem and importance. Heart transplantation itself emerged directly from modern medicine's avowed vocation to retrieve patients from death's door. Technology, with its attendant ideology of rational triumph, offered physicians the possibility of reliable miracles. There were, however, two serious problems inherent in the ethos of organ transplantation. First, the miracles were not reliable. Early transplantation subjects typically died gruesome painful deaths as a direct consequence of the surgery or early immunosuppression practices such as total body irradiation. Second, in principle, organ transplantation technically required physicians to abandon the mission of saving all lives at any cost, in favor of a more utilitarian objective of declaring defeat in some cases in the interest of others. Most visibly in the practice of heart transplantation, it actually required physicians by traditional understanding to "kill" two desperately ill patients by removing their hearts, in order possibly to restore one of them to health. The rhetorical construction of a definition of brain death above all had to draw useful limits around medicine's mission to defy death, by allowing the work to proceed in the name of lifesaving while drawing new boundaries between the hopeless, the dead, and the living.

Medical technology is often understood as following a sort of a natural life cycle, within the "ecological" environment of economic and social systems. Life cycle theories have been particularly popular in the field of medical technology assessment, to explain the process of diffusion and choose points of intervention. In this view, all technologies progress through a number of developmental stages, for example: experimentation, innovation, acceptance, general use, and obsolescence.[171] For medical technology, John McKinlay has described this life cycle in terms of a "career" with seven stages, the "promising report," professional and organizational adoption, public and payor acceptance, standard procedure, clinical trials, professional denunciation, and erosion and discreditation.[172] McKinlay's stages reveal that diffusion does not necessarily ebb and flow with rational consideration of a technology's effectiveness. Rather,

> ...the success of an innovation has little to do with its intrinsic worth (whether it is measurably effective, as determined by controlled experimentation) but is dependent upon the power of the interests that sponsor and maintain it, despite the absence or inadequacy of empirical support.[173]

Consequently, medical practices typically become institutionalized by processes which operate independently of technology assessment. Koenig has more specifically described how a technology becomes established as through the socialization process of "routinization." Once socially regarded as routine rather than experimental, technology accrues a moral force which ensures its application, regardless of its efficacy rates. Moral imperatives transform into technological imperatives.

Technological success depends upon a process of social institutionalization. Once it has substantial organizational investment and a consequent moral force, a treatment becomes a formidable institution which is not as easily dislodged by scientific or popular controversy about its effectiveness or other effects. Technology need only get a foot in the door of the hospital in order to establish itself as entitled to social and technical accommodation characteristic of "reverse adaptation" described above.[174] Technology seems to become an agent in its own right, even "looking out for its own" by ushering in other technological innovations. The definition of brain death was based upon already established practices of organ procurement, and in turn bolstered the legitimacy of transplant research, helping to "routinize" transplantation despite dismal survival rates in the early 1970s.

Winner has proposed that, once designed and established, technological artifacts act as "legislation." This model acknowledges technologies are human-made and their deployment a matter of choice; they are indeed tools. Yet, the specific features of these tools *by design* implicitly organize human activity without explicitly prescribing it through more easily recognized channels such as social policy or law:

> "[t]he things we call technologies are ways of building order in our world...By far the greatest latitude of choice exists the very first time a particular instrument, system, or technique is introduced. Because choices tend to become strongly fixed in material equipment, economic investment, and social habit, the original flexibility vanishes for all practical purposes once the initial commitments are made. In that sense technological innovations are similar to legislative acts or political foundings that establish a framework for public order that will endure over many generations.[175]

By focusing on technical requirements and retaining policy discussions in technical terms, professional technicians prevent public involvement in matters which would normally be resolved in the domain of political action. In the case of brain death, technological limitations and capacities literally "legislated" a new concept of death, and this concept of death literally gave legal authority to practices in transplantation. However, transplantation also more implicitly legislated the language and metaphor which would circumscribe policy discussions concerning death for the next three decades.

The practice of transplantation depended upon a highly mechanistic, utilitarian perception of the body and its function. Conceptually incompatible "mysteries" of all sorts had to be dismissed or deferred to allow transplantation to progress as envisioned. Most visible from a biomedical perspective was the problem of immunology. Transplant surgery was applied to human beings once the procedure was mechanically perfected, and many years before the postoperative problems of graft rejection were understood and manageable. Survival rates were consequently poor in the early years. Immunology was an important concern, a "frontier for research," but was never considered the essence of transplantation. Intrinsic cultural "mysteries" such as the morality of human research, rituals of death, rites of passage, spiritual beliefs, and emotional commitments repeatedly challenged the premises and practices of transplant experiments without fundamentally hampering their progress. Even dilemmas clearly within the code of medical ethics, such as the utilitarian redistribution of body parts meaning that one patient could be helped only if another were harmed, failed to impede the research. Likewise, the problem of taking organs from dead or not-quite-conventionally-dead bodies was recognized and set aside rather than resolved in the early years. Discussions of the "ethical problems of transplantation" did not even entertain the possibility that unresolved ethical problems should preclude the practice of transplantation. The icon of transplantation evoked in policy discussions remained its mechanical engineering, the potentially lifesaving salvage of spare parts from one person to make another new again. Transplantation was essentially regarded as surgery, *good* surgery. Its essence did not lie in its many conceptual and physical paradoxes.

Personhood has become the major conceptual touchstone in academic discussions of brain death, as modern professionals debate how completely the brain need be destroyed before the "person" is irretrievable, and thus "socially dead." Professionals in the 1960s strove to translate social imperatives into physiological processes; today professionals translate those physiological processes back into their contemporary social meaning, and argue that the physiological line between life and death was drawn arbitrarily. If to be brain dead means the physiological loss of personhood, then the apparent, or more socially determined loss of personhood (i.e., persistent vegetative states and the like) should be translated into "updated" physiological descriptors of brain death. The imperatives of transplantation in 1968 conjured the image of the ideal organ donor, whose physiological state was prescribed and codified as brain death. Today the imperatives of health economics conjure the image of the unresponsive, unproductive health resource consumer, whom some now propose to institutionalize as "dead" as well. Despite the physiological character of brain death criteria, they have been formed not only by laboratory-produced physiological "knowledge", but also by controversial *ideas* about the technological and economic uses of death, as well as what it means to be "alive".

This historical analysis has demonstrated how powerfully the interests of kidney and heart transplant research both compelled and shaped the redefinition of death in 1968. The EEG and life support, as well as less directly involved technologies such as open heart surgery and artificial organs, also played their parts in negotiating the questions and answers which would alter the medical meaning of human life and death. While the capacities of life support and the EEG, and the social burden of caring for the terminally comatose entered into the *process* of redefining death, they did not of themselves create the urgent "need" to do so. Transplantation overwhelmingly built the historical pressure to redefine death in 1968. In the hypothetical absence of transplant technology, the more slowly germinating concerns about the meaning of life, personhood, and medical resources may have mobilized a demand for the a redefinition of death. However, it probably would have happened much later than 1968; an analogous process is evident in the slow evolution of the euthanasia movement brought into sharp focus in the late 1970s by the famous Karen Quinlan case. The concerns would first have had to be balanced against a medical ethos entrenched in "heroic" lifesaving, together with all of the deeper cultural skepticism which has made the redefinition of death so unpopular in practice. The Harvard Committee, driven by the spirit of transplant research, was uniquely able to harness an element of this very formidable "resistance" - the passionate commitment to high technology intervention - to drive through a redefinition of death. This foray succeeded within the world of medical research, however, it has foundered on the rockier road to popular convention.

Notes:

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1 Peter Brian Medawar, 1946, "Old age and natural death", p. 18. Dr Henry Beecher, the Chairman of Harvard Medical School's Ad Hoc Committee to Examine the Definition of Brain Death in 1968, was fond of quoting Dr. Medawar's statement in his talks and papers following the publication of the Ad Hoc Committee's report.

2 Joynt, 1984. p. 680.

3 "Death," 1987, *Encyclopedia Brittanica*, p. 1035.

4 Korein, 1978, "The problem of brain death: development and history," p. 20.

5 Pernick, p. 57.

6 Rothman, 1991.

7 Rothman, p. 159.

8 Rothman, p. 161.

9 This sculpting metaphor resonates with a contemporary ethnographic analysis by Hirschauer (1991) of the "manufacture" of the body through the activities of surgery. Hirschauer demonstrates how physical and technical manipulations of the patient in the operating room disassociate the person from the body, the surgeon and patient alike become continuously interdependent with life support and surgical technologies, and dissection protocols classify the body according to anatomical norms. Such rituals aid not only in cutting through the body to get the work done, but in cutting through deep cultural taboos against bodily violation. In Hirschauer's words, "Wounding somebody has become wounding some body, and so it appears undramatic." (p.299)

10 Quoted from *The American Illustrated Medical Dictionary*, 1951, and *Dorland's Illustrated Medical Dictionary*, 1965. Similarly, a dictionary from a different publisher defined life in 1966 as, "vitality; the essential condition of being alive; or existance of animals and plants; the state of existance characterized by active metabolism." (*Stedman's Medical Dictionary*, 1966)

11 Two such cases are described in detail in R.W. Waggoner and K. Scharenberg, 1955, "Contribution to the knowledge of acute brain death."

12 Waggoner and Scharenberg, 1955. Underlying diseases included convulsive disorders, metabolic disorders, toxic conditions, allergic reactions, viral diseases, "obscure diseases of the body and brain", and complications of surgery or other trauma. Histological examination of a sample of cases showed a common pathology of ameboid disintegration of glial cells, a result of unexplained physiological processes.

13 Waggoner and Scharenberg, 1955.

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14 See Pernick, 1988; Alexander, 1980.

15 Current fears are documented in: U.S. Department of Health and Human Services, 1986. This report cites a 1985 Gallup poll of public attitudes towards organ donation which determined the two leading reasons for refusing to donate organs to be: "They might do something to me before I am really dead" and "Doctors might hasten my death"; the more distantly roots of these fears are described by several authors. E.H. Ackerknecht, 1968, "Death in the history of medicine." Ackerknecht points out that the dwindling belief in afterlife and the increased emphasis on material experience brought about by the Enlightenment made the loss of life and its economic consequences less bearable. Mistaken death and live burial thus became a new kind of "secularized hell". Farrell, 1980, proposes that more specifically, the popular assimilation of naturalism in the nineteenth century helped to transform the social meaning of death into a biological matter of fact, and turn any realistic hope for immortality toward science. Other accounts of premature burial and the professionalization of death include Pernick, 1988, and Alexander, 1980.

16 John D. Arnold et al, 1968, "Public attitudes and the diagnosis of death."

17 J. Gerald Kennedy, 1977, " Poe and magazine writing on premature burial."

18 Stern, 1973. "The Premature Burial" was originally published in *The Dollar Newspaper*, July 31, 1844.

19 Alexander, for example, cites a 1749 poem written in gratitude to Bruhier's essay on premature burial:

"...To restrain the greedy inheritor

Whose homocidal alacrity

Would place us too quickly

In a church or cemetery."

(Alexander, 1980, p. 29, citing: Bruhier, Dissertation sur l'incertitude des signes de la mort, et l'abuse des interremens et embaumens precipites. 2nd ed. Paris, 1749)

20 This term was coined by the press. See chapter 8 in Fox and Swazey, 1978.

21 Arnold et al, 1968, p.1951.

22 Farrell, 1980.

23 Alexander, 1980.

24 Italics in original, Alexander 1980, p. 30.

25 Arnold, 1968, gives and interesting account of examples of gimmicks and systems devised to detect life in the apparently dead: Mortuaries were established for observation of the dead, there bells were attached to gloved cadaver hands to detect

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slight movements and an attending watchman punched a time clock every half hour in disciplined wakefulness. Deceased men and women were held in separate areas of the mortuary, perhaps to avoid improprieties among the miraculously recovered. After attending a funeral during which the corpse awoke, the Russian Count Karnice-Karnicki invented a coffin with a spring-loaded mechanism to raise a flag above ground in response to any breathing movements in the buried.

26 Moore, 1964, p.153.

27 Moore, 1972.

28 Wolstenholme and O'Connor, 1966, p. vii.

29 Kilbrandon, 1966.

30 Murray, 1966, p.59

31 G.E. Screiner's comments at the Ciba symposium, in: Wolstenholme and O'Connor, 1966, p. 154.

32 Joseph Murray's comment in: Wolstenholme and O'Connor, 1966, p. 207.

33 Murray, 1964, p. 56. Italics in original.

34 Wolstenholme and O'Connor, 1966, p. 19.

35 Bentley's comment in: Wolstenholme and O'Connor, 1966, p. 208.

36 Joseph Murray, 1966, "Organ transplantation: the practical possibilities," p. 65

37 Murray, 1966, p. 55.

38 Wolstenholme and O'Connor, 1966, pp. 210-211.

39 Woodruff, 1966.

40 Moore, 1964, pp.132-133.

41 Moore, 1964, p. 146

42 Wolstenholme and O'Connor, 1966, p. 71.

43 Wolstenholme and O'Connor, 1966, p. 157.

44 Wolstenholme and O'Connor, 1966, p. 163.

45 Comment by Starzl at Ciba Conference, in: Wolstenholme and O'Connor, 1966, p. 155.

46 Wolstenholme and O'Connor, 1966, p. 72.

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47 Wolstenholme and O'Connor, 1966, pp. 72, 73.

48 Murray, 1966, pp. 61, 63.

49 Comment by Giertz, Wolstenholme and O'Connor, 1966, p. 155.

50 Wolstenholme and O'Connor, 1966, p. 161.

51 Comment by Sir Robert Platt, in: Wolstenholme and O'Connor, 1966, p. 155.

52 Comment by Woodruff at the Ciba conference, in: Wolstenholme and O'Connor, 1966, p. 157.

53 E.g., Annas, 1987; Annas, 1983.

54 Julius Korein, 1978, "The problem of brain death: development and history," p. 26.

55 University of California legal scholar D. W. Louisell's comment at the Ciba conference, in: Wolstenholme and O'Connor, 1966, p. 79.

56 Comment by British medical professor Sir George Pickering at the Ciba conference, in: Wolstenholme and O'Connor, 1966, p. 65.

57 Moore, 1964, p. 148.

58 Comment by Louisell, in: Wolstenholme and O'Connor, 1966, p.92.

59 Comment by American renal specialist G. Schreiner, in: Wolstenholme and O'Connor, 1966, p. 68.

60 Wolstenholme and O'Connor, 1966, pp. 155-156, italics added.

61 Wolstenholme and O'Connor, 1966, p. 70, italics added.

62 The philosophical, anthropological, and religious dimensions of popular cultural beliefs about the integrity of the body are beyond the scope of this study. The very basic problem, evident in the popular sources reviewed in this study, was that researchers made more "progress" the more methodically they were able to dissect the body and its functions, while the populace retained an innate resistance to viewing human bodies as anything but whole. Most incisions, unless clearly therapeutic, are still viewed negatively, as "violation" or "mutilation." This taboo against wilfully disintegrating the body applies to the dead as well as the living.

63 Henry K. Beecher, 1970, "Definitions of 'life' and 'death; for medical science and practice."

64 Korein, 1978.

65 Louise Russell, 1979.

66 W.J. Freeman, 1956.

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67 Anonymous, 1957, "A way of dying"."

68 Letters to the editor in response to "A way of dying" can be found in *The Atlantic Monthly*, March 1957 issue.

69 "Life-in-death," 1957.

70 "Life-in-death," 1957.

71 Pius XII, 1958, "The prolongation of life."

72 The Ad Hoc Committee, 1968.

73 "Pius gives view on saving dying; tells when doctors may give up," 1957.

74 "Doctors may stop efforts to delay death, Pope says," 25 November 1957, p.1.

75 The following analysis is based on a review of the 15 such articles published in the *New York Times* between 1937 and 1957 (listed in bibliography). Most of these stories came from wire services and probably were published in many American newspapers.

76 "Man, 70, in coma seven weeks," 14 Jan 1949.

77 "Girl in coma 173 days, physicians abandon hope," 9 July 1949.

78 "2,000 days in a coma; Cincinnati patient, struck on head in '43, is healthy," 1 Aug 1948.

79 Henry K. Beecher, 1966.

80 Fox and Swazey, 1978.

81 Titmuss, 1971. Consider also for comparison that the body of a health adult contains only about 12-13 pints of blood.

82 Pressman, 1988.

83 See e.g., Hamlin, 1964. An interesting example of such lifethreatening surgical technique is the use of elective cardiac arrest to hold the heart still and keep it from bleeding during heart surgery emerged in the mid 1950s. See Hale, et al, 1957. Ironically, some of the rhetoric justifying the relocation of the site of life (for the purpose of determining death) from the heart to the brain included the argument that because heart transplants involved removal of the heart, the practice would be tantamount to killing the patient according to conventional criteria, and transplant surgeons would automatically be guilty of murder. I did not uncover evidence of any analogous ethical interest in the practice of deliberately stoppin the heart during open heart surgery, although surely these early pioneers of open heart surgery were guilty of (usually temporarily) "ending life" in the same sense.

84 See Galla et al, 1958.

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85 Cited in Korein, 1978: P. Mollaret and M. Goulon, 1959, "Le coma depasse," Rev. Neurol. 101:3-15; H. Fischgold and P. Mathis, 1959, "Obnubilations, comas, et stupeurs," Electroenceph. Clinic. Neurophysiol. 11:Suppl.; M. Jouvet, 1959, "Diagnostic electro-sous-cortico-graphie de la mort du systeme nerveux central au cours de certains comas," Electroenceph. Clin. Neurophysiol. 11:805-808.

86 Carlo Loeb, 1958.

87 Bickford et al, 1965.

88 Tentler et al, 1957.

89 H. Hamlin, 1965, "The EEG in determination of death." (italics added)

90 H.M. Hauser and E.J. Brewer, 1966, "Death?"

91 J. Carbonell et al, 1962, "Some electrophysiological observations in a case of deep coma secondary to cardiac arrest."

92 Hamlin, 1964.

93 Hamlin, 1964, p.113.

94 Hamlin, 1964, p. 114.

95 Schwab et al, 1963; Hamlin, 1964.

96 Schwab et al, 1963.

97 Among the popular articles on the theme of organs as "spare parts" are: *Harper's Magazine*, 1955; *Life*, 1958; *Time*, 15 December 1967; *New York Times*, 9 September 1968; *Science Digest*, June 1967.

98 Moore, 1964.

99 Stevens, 1955 [italics added].

100 "Gift of a Heart," 1967, p. 27.

101 "Surgery: the ultimate operation," 1967, p. 64.

102 "The heart: miracle in Cape Town," 1967.

103 Newsweek, 1967, p. 88.

104 "The heart: miracle in Cape Town," 1967.

105 Time, 1967, p. 71.

106 Arnold et al, 1968, p. 1953-4.

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107 Beecher, 1966.

108 Beecher, 1966, p.1354.

109 The Ad Hoc Committee of the Harvard Medical School to Examine the Definition of Brain Death ("The Ad Hoc Committee"), 1968, "A definition of irreversible coma."

110 The Ad Hoc Committee, 1968, p.85.

111 Interview with William Curran, 15 August 1989, Harvard School of Public Health.

112 Robert H. Ebert to Joseph Murray, 4 January 1968, from the files of Henry K. Beecher, Holmes Hall, Harvard Medical School.

113 "Definition of irreversible coma", manuscript draft of 11 April, 1968, p. 1, from the files of Henry K. Beecher.

114 "Definition of irreversible coma", manuscript draft of 11 April, 1968, p. 13, from the files of Henry K. Beecher.

115 "Definition of irreversible coma", manuscript draft of 11 April, 1968, p. 16, from the files of Henry K. Beecher.

116 A definition of irreversible coma," manuscript draft of 3 June, 1968, p. 1, , from the files of Henry K. Beecher.

117 Everett I. Mendelsohn to Henry Beecher, 5 June 1968, from the files of Henry K. Beecher. It is assumed that this letter was in response to the June 3 draft.

118 Robert H. Ebert to Henry K. Beecher, 1 July 1968, from the files of Henry K. Beecher.

119 See Jack Pressman, 1988, "The EEG: a medical technology in search of a function," for a discussion of the evolution of the technology's applications, and how the meaning of EEG readings changed with the projections of evolving social interests onto those "miles and miles of squiggly lines."

120 Interview with William Curran, 15 August, 1989.

121 Interview with William Curran, 15 August 1989.

122 Statistic adapted from Pressman, 1988.

123 Beecher, 1969, p.3

124 Waltregny et al, 1970

125 Potter, 1968, p. 792.

126 William Curran to Robert Schwab, Robert Ebert, and Joseph Murray, 28 March 1968, from the files of Henry K. Beecher..

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127 Henry Beecher to Robert Ebert, 28 March 1968, from the files of Henry K. Beecher..

128 "Definition of irreversible coma", manuscript of 11 April 1968, from the files of Henry K. Beecher..

129 Coe and Curran, 1980.

130 Veith, 1978.

131 Walton, 1979, p. 30.

132 Harp, 1974, p. 392.

133 "Definition of irreversible coma", manuscript draft of 11 April, 1968, p. 3, from the files of Henry K. Beecher..

134 Coe and Curran, 1980.

135 The legislation is described in more detail in, Rado, 1981; Coe and Curran, 1980.

136 "Definition of Irreversible Coma", line edited manuscript of 11 April, 1968, from the files of Henry K. Beecher..

137 Joseph Murray to Henry Beecher, 28 March, 1968, from the files of Henry K. Beecher..

138 Memo from Derek Denny-Brown to Henry Beecher, "Comments on Definition of Irreversible Coma," reviewed by Beecher 4/26/92, from the files of Henry K. Beecher..

139 "Definition of Irreversible Coma", line edited manuscript of 11 April, 1968, from the files of Henry K. Beecher..

140 Potter, 1968, p.786.

141 Potter, 1968, p.789.

142 Henry Beecher to Robert Ebert, 9 January 1968; "Report of the ad hoc committee to examine the definition of brain death now presented as a definition of irreversible coma, respectfully submitted to Robert H. Ebert, Dean", manuscript of 13 June 1968, from the files of Henry K. Beecher.

143 Schwab et al, 1963; Murray, 1966.

144 Moore, 1964.

145 "Definition of irreversible coma," draft of April 11, includes citations to: Alderete et al, in press; Rosoff and Schwab, 1967 (no additional information given), and

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Pickering, 1966 (no additional information given), from the files of Henry K. Beecher..

146 George H. Williams to Henry Beecher, 23 January 1968, from the files of Henry K. Beecher..

147 "A definition of irreversible coma," manuscript draft of 3 June, 1968, p. 5, from the files of Henry K. Beecher..

148 Mendelsohn to Beecher, 5 June 1968, from the files of Henry K. Beecher..

149 The Ad Hoc Committee, 1968, p.87.

150 Moore, 1972.

151 Some policymakers combat this attitude as irrational and wasteful, for example, see: Prottas and Batten, 1988; Stuart J. Youngner et al, 1989.

152 Statistics cited in: U.S. Department of Health and Human Services (DHHS), 1986.

153 DHHS, 1986.

154 Statistics adapted from Crane, 1975.

155 This conclusion is based on a survey of the dictionaries easily available for reference at the Countway Medical Library in Boston:

The American Illustrated Medical Dictionary, 1951

Dorland's Illustrated Medical Dictionary, 24th edition, 1965

Stedman's Medical Dictionary, 21st edition, 1966

Butterworth's Medical Dictionary, 2nd edition, 1978

Dorland's Illustrated Medical Dictionary, 27th edition, 1988

156 *Butterworths Medical Dictionary*, 2nd edition, 1978.

157 Krupp et al, 1985.

158 For more on this legislative movement, see: Rado, 1981; and Korein, ed., 1978.

159 E.g., Pallis, 1982; Pallis, 1986.

160 "Brain dead ex-person" is Christopher Pallis' term (1986, p.86). "Organ harvest" is commonly used throughout contemporary organ transplantation literature.

161 The potentially "gender biased" term "men" is used intentionally here; this historical analysis has concerned the actions and rhetoric of men almost exclusively. No doubt women were involved in discussions and practices related to brain death, the

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comatose, the EEG, and transplantation, but their voices are absent from the sources discovered in this research.

162 The first use is endemic among contemporary health economists. Victor Fuchs is credited with introducing the phrase "technological imperative" into health policy discussion 1968, as part of an indictment of the high cost and marginally decreasing benefits of medical progress (Fuchs, 1968).

163 E.g., McKinlay, 1981.

164 E.g., as described in part by Pfaffenberger, 1988.

165 A case study using perspective in medicine has been published by Waitzkin (1979). A more conventional economic treatment of high technology as a marketing tool is provided by Robinson (1988).

166 This phenomenon is described by Winner (1980). This perspective has also been described as "contextualist" and applied in a case of medical technology by Tannenbaum (1986).

167 E.g., Bijker, Hughes, and Pinch, 1989.

168 Winner, 1977, p. 241.

169 Winner, 1977, pp. 242-251. The points are reordered here.

170 Recounted by O.H.Frazier in Pierce et al, 1989, p. 99.

171 Institute of Medicine, 1985, *Assessing Medical Technologies*.

172 McKinlay, 1981.

173 McKinlay, 1981, p. 398.

174 For an illustrative case study of this "foot in the door" phenomenon in the introduction of X-rays and electrocardiographs in the early 20th century, see Howell, 1986.

175 Winner, 1980, pp. 127-128.

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Appendix 1. Summary of Proposed Brain Death Criteria, 1964 to 1968

	Harvard 1964	**Harvard 1964**	**Ciba Discussants 1966**		**Harvard 1968**
	Moore	Schwartz, Hamlin	Alexandre	Revillard	Harvard
No heartbeat	▨				
No blood or oxygen to brain	▨ **8-10 min**			▨	
No reflexes	▨	▨	▨	▨	▨
Pupils dilated	▨		▨	▨	▨
Flat EEG	▨	▨	▨ **Several Hrs**	▨	▨
No spontaneous respiration		▨ **60 min**	▨ **5 min**	▨	▨ **3 min**
Normal lab data incl. electrolytes		▨			
Falling blood pressure			▨		
No response to atropine				▨	
No spontaneous movement					▨
No hypothermia					▨
No CNS depressants					▨
Repeat confirmation of criteria		▨ **Optional**			▨ **24 hrs**

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