

## HISTORY OF MEDICINE

### Will We Code for Default ECMO?

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#### Abstract

Cardiopulmonary resuscitation has become the default treatment for all patients who suffer cardiac arrest. The history of how this came to be suggests the clinical and ethical importance of establishing more humane and appropriate indications for extracorporeal membrane oxygenation and other aggressive therapies for patients at the end of life.

#### Doing Everything

Development of new medical technologies has potential to greatly improve patients' lives but also raises questions about how to establish standards of care for applying them. Increasing application of extracorporeal membrane oxygenation (ECMO)—especially as an adjunct to cardiopulmonary resuscitation (CPR), termed ECPR—presents us with an opportunity to establish sensitive and humane use standards. Such standards would pose a stark contrast to using CPR and other “life-saving” procedures to treat cardiac arrest in all critically ill and dying patients without a do-not-resuscitate (DNR) order. CPR became the default treatment for cardiac arrest in hospitals in the early 1970s and established a precedent for the current standard of “doing everything”—that is, applying all indicated procedures, regardless of whether they are expected to help a specific patient. It was only later that [DNR orders](#) were established, placing the onus on patients or surrogates to opt out. The do-everything precedent, however, suggests that as ECMO becomes increasingly accessible, it, too, will likely be added to the list of what is included in everything physicians do by default and that patients come to expect, perhaps prompting the need for do-not-ECMO orders.

This article examines parallels between the early history of CPR and ECMO. We argue that similar forces that led to CPR becoming indicated in all cases of cardiac arrest are currently driving the expansion of indications for ECMO. Understanding these forces is essential to establishing more humane and appropriate indications for these aggressive therapies and may prevent them from becoming “default” treatments for all dying patients.

#### A Brief History of ECMO

ECMO is a life-supporting treatment that supplants the function of the lungs, the heart, or both, typically applied when patients' illnesses are refractory to other standard procedures. ECMO's earliest incarnation was referred to as the “mechanical heart and

lung.”<sup>1</sup> First successfully applied in the 1950s to bypass a patient’s heart, thereby revolutionizing cardiac surgery, ECMO was initially confined to operating rooms.<sup>1</sup> After development of a compact portable battery-operated “roller pump” in the 1960s, ECMO could be used outside operating rooms, and its indications expanded to include acute respiratory distress syndrome, bridge to transplant, sepsis, and resuscitation.<sup>2</sup> The first successes of ECMO as an adjunct to CPR in select cases of cardiac arrest were reported in 1976.<sup>3</sup> Although use of ECPR has increased in the last decade, 2 recent meta-analyses of the procedure suggest that ECMO should be used as an adjunct to CPR or as an alternative to resuscitation alone in patients with reversible etiologies for their arrest (ie, not at the terminus of diseases expected to end in death).<sup>4,5</sup> This limited indication for ECPR appears to be fairly well established and was echoed in an editorial commenting on 12 years of data from the Extracorporeal Life Support Organization,<sup>6</sup> which defined ECPR as “implantation of veno-arterial extracorporeal membrane oxygenation (VA-ECMO) in a patient who experienced a sudden and unexpected pulseless condition attributable to cessation of cardiac mechanical activity.”<sup>7</sup>

### **Innovating CPR Protocol?**

Although current standards for ECPR stipulate limited indications and specific locations, experts cannot help but wonder about where and for whom the procedure should be used. This concern was articulated in an editorial titled “ECPR: Are We Ready for Primetime?,”<sup>8</sup> which accompanied a previously mentioned meta-analysis. In addition to implying that the indications for and application of ECPR had expanded, the title of the editorial raises an unspoken question: Should ECPR become part of the CPR protocol? Although the meta-analysis reported overall greater survival to hospital discharge for ECPR compared to conventional CPR,<sup>4</sup> a reasonable answer to this question, for the time being, is “not yet.” The authors of the editorial suggested that the meta-analysis included too few publications, was “incomplete,” and that “ECPR should only be performed in selected circumstances and in those institutions that have 24-hours-a-day extracorporeal support systems in place.”<sup>8</sup> The authors also stipulate, as do many articles on ECPR, that “Ethical considerations as to who should receive ECPR, and who should not get it, need to be properly addressed.”<sup>8</sup>

What should be the role of ethics in establishing [standards for ECPR](#)? Responses to this question have included calls for more evidence about benefits and risks, for evaluating potential patients’ preferences, and for consideration of economics.<sup>9</sup> Establishing default CPR for all cardiac arrest meant that many patients, the vast majority of whom died in hospitals, underwent the procedure despite its not offering hope of meaningful life extension. The parallel early histories of CPR and ECMO suggest that the forces that contributed to CPR’s expanding indications and that ultimately led to its default application are also driving ECMO’s use trajectory.

## History of Default Care for Cardiac Arrest

Treatment of cardiac arrest was mostly confined to the operating room until the 1950s when a few bold surgeons encouraged applying the technique, which involved open cardiac massage, in other areas of the hospital and beyond. This development meant that, until 1950, cardiac arrest was for the most part only diagnosed in the operating room because it was there that the procedure to treat the condition could be applied. The definition of cardiac arrest and, with it, the indications for resuscitation, greatly expanded when the much-less-invasive closed method of resuscitation was developed in the late 1950s.

When the originators of CPR, which combined the closed method with mouth-to-mouth ventilation, convened for a roundtable discussion at the *Chest* meetings in 1962, they began by defining indications for the new therapy.<sup>10</sup> Peter Safar, a developer of and advocate for mouth-to-mouth ventilation, opened the roundtable by posing a definition of cardiac arrest as an indication for the new technique: "I would like to define cardiac arrest as the clinical picture of cessation of circulation in a patient who was not expected to die at the time."<sup>10</sup> He then asked James Jude if he agreed with his definition. Jude, one of the developers of external cardiac massage at the Johns Hopkins University School of Medicine and the sole physician on the first article on the technique, published in 1960,<sup>11</sup> replied, "It's a very good one."<sup>10</sup> The markedly diminished burdens of CPR compared to the more invasive open technique that it replaced led to an expansion of CPR's indications throughout the 1960s, but the limits of the procedure were still appreciated by many and guided practice in those hospitals accordingly.<sup>12</sup>

Evidence that CPR had not yet become the default treatment for cardiac arrest during the 1960s comes from several sources. Jude, along with James Elam, another developer of CPR also at the 1962 *Chest* conference roundtable, published the first CPR manual in 1965, *The Fundamentals of Cardiopulmonary Resuscitation*. The manual begins with a description of patients for whom CPR is indicated: "The patient must be salvable ... resuscitative measures on terminal patients will, at best, return them to the dying state."<sup>13</sup> Three years later, in an article about uses of life-saving treatments such as cardiac resuscitation, the attorney John Fletcher states:

The moral of our circular journey is that doctors are in a position to fashion their own law to deal with cases of prolongation of life. By establishing customary standards, they may determine the expectations of their patients and thus regulate the understanding and the relationship between doctor and patient. And by regulating that relationship, they may control their legal obligations to render aid to doomed patients.<sup>14</sup>

Fletcher's call for developing "customary standards" for cardiac resuscitation speaks to the lack of an established standard at the time. It was only after CPR was established as the default treatment for cardiac arrest that DNR orders became necessary. The first mention of the DNR order does not appear in the medical literature until 1972,<sup>15</sup> and it was formally codified by the American Heart Association in 1974.<sup>16</sup> The standard of default CPR thus was not established before 1970 (see Table).

**Table.** History of Default CPR Becoming the Standard Care

Pre-default Event	
1965	Jude and Elam publish <i>The Fundamentals of Cardiopulmonary Resuscitation</i> , which began, “The patient must be salvable ... resuscitative measures on terminal patients will, at best, return them to the dying state.” <sup>a</sup>
1968	Fletcher argues for the development of sensitive and humane standards for the care of patients who are clearly dying, implying a standard is not yet in place. <sup>b</sup>
Post-default Event	
1972	First mention of “Do Not Resuscitate” orders appears in the medical literature in a perspectives piece on patient death. <sup>c</sup>
1974	The American Heart Association officially codifies the “Order not to Resuscitate.” <sup>d</sup>
<sup>a</sup> Quoted from Jude and Elam. <sup>13</sup> <sup>b</sup> From Fletcher. <sup>14</sup> <sup>c</sup> From Janes. <sup>15</sup> <sup>d</sup> From “Standards for Cardiopulmonary Resuscitation (CPR) and Emergency Cardiac Care (ECC).” <sup>16</sup>	

Proponents of ECPR are to be congratulated for their prudence to date in limiting its indications, but the parallels between ECPR and CPR more than half a century earlier are startling: ECPR appears poised to follow in CPR’s footsteps by becoming the default treatment for cardiac arrest—an example of the *technological imperative*.

### **The Technological Imperative and Coding CPR as a Billable Procedure**

The technological imperative—the overapplication of technological solutions to an increasing range of problems—has been appreciated in medicine since at least the 1980s, when Howard Spiro discussed it at an eponymous conference. Spiro, then chief of general internal medicine at Yale University, identified the force driving the ever-increasing application of technological procedures when he remarked:

We are all encouraged to do more in the way of technological activities today than 10 or 30 years ago simply because the third-party payers pay for technology and not for thinking. When you talk with the officials, they point out that it is easy to assess the costs of the procedures but difficult to assess the cost of a thought.<sup>17</sup>

The truth of Spiro’s remarks is manifest in the temporal relationship between CPR becoming the default option for all patients who died in hospitals in the early 1970s and its listing as a billable procedure in the second edition of the *Current Procedural Terminology* (CPT) manual, published in 1970 by the American Medical Association (AMA).<sup>18</sup>

In 1966 the AMA published the first CPT manual, which was much smaller and narrower in scope than the second edition, so that physicians and administrators could begin billing Medicare for procedures.<sup>19</sup> The new 1970 CPT code read “CPR for Cardiac Arrest ... 96000” and, very soon, cardiac arrest came to mean all cases of cessation of circulation, regardless of the context of the patient. The default application of CPR thus became the standard of care.

A brief overview of the CPT codes for ECMO highlights an important difference between ECMO and CPR codes. The first instance of CPT coding for ECMO occurs in the 4th edition, published in 1977: “33960 ... Prolonged extracorporeal circulation for cardiopulmonary insufficiency.”<sup>20</sup> After several revisions, the current CPT codes for ECMO were established in 2015,<sup>21</sup> with 16 different codes referring to specific aspects of the procedure: placement, repositioning, and removal of peripheral or central cannulas, for example, are further subdivided into open or percutaneous approaches. Of note, these various CPT codes are not linked to specific indications, as were CPR codes for cardiac arrest. This history suggests that one way to avoid ECPR becoming the default treatment for all cardiac arrest would be not to create a CPT code that links it to cardiac arrest.

### **Other Lessons**

The gauntlet has already been thrown down for hospitals to provide around-the-clock ECMO teams before they will be sanctioned to provide ECPR, paralleling the creation of code teams for CPR in the 1960s.<sup>22</sup> Although American Heart Association guidelines state that “[t]here is insufficient evidence to recommend the routine use of ECPR for patients with cardiac arrest,”<sup>23</sup> it is likely only a matter of time before data will be collected that incontrovertibly show ECPR to be superior to CCPR, but only in select patients. One lesson from the history of CPR is this: cardiac arrest that includes all cases of cessation of blood flow should never be a blanket indication for ECPR. Another is that patients should not be forced to become do-not-ECMO to avoid the harms of ECPR. Instead, physicians need to make judgments about who would likely benefit from the procedure and decide with patients and families if this is something they would want. The history of CPR suggests the importance of defining the limits of any kind of resuscitation. By raising the stakes of resuscitation, ECPR also pushes us to better define these limits. By illuminating the temporal link between CPT codes and standards of care for CPR, this history also raises the question of CPT codes’ influence on other procedures and their standards.

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