Fallible humans in resuscitation

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Abstract:

Using an actor-network theory approach, this paper analyses two technologies used in resuscitation medicine to try to improve outcomes from cardiopulmonary resuscitation, which remain an ongoing disappointment to resuscitation practitioners. The technologies are mechanical chest compression, and the use of automatic external defibrillators in hospital. In both cases, the actor network that performs resuscitation is being rebalanced away from humans and in favour of machines. Despite these efforts, outcomes from resuscitation continue to be worse than resuscitation medicine would like. This paper analyzes why there has been such persistence (in one of the cases for over 40 years) with apparently 'failed' technologies, concluding that it is a way of ensuring medical control over the process.

Keywords: resuscitation, defibrillation, mechanical chest compression, Actor-network theory

Résumé:

Etres humains faillibles dans la reanimation

Utilisant une approche de théorie d'acteur -réseau, cet article analyse deux technologies employées dans la médecine de ressuscitation pour essayer d'améliorer les résultats de la ressuscitation cardio-pulmonaire qui continuent à être décevantes aux praticiens de ressuscitation. Les technologies sont compression mécanique de la poitrine et l'utilisationà l'hôpital de défibrillateurs externes automatiques. Dans les deux cas, le réseau d'acteur qui exécute la ressuscitation est retiré des humains pour être remplacé par des machines. Malgré ces efforts, les résultats de la ressuscitation continuent à être pire que la médecine de ressuscitation le voudrait. Cet article analyse pourquoi il y a eu une telle persistance (dans un des cas pendant plus de 40 ans) avec, apparemment des technologies qui n'ont pas réussi, tirant la conclusion que c'est une façon d'assurer le contrôle médical du processus.

Keywords: ressuscitation, défibrillateurs, compression mécanique de la poitrine, théorie d'acteur –réseau

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Introduction

Resuscitation has a problem. Despite the cultural imperative of saving lives, the impressive array of technology deployed by its practitioners, and the sophisticated socio-technical systems put in place (in developed countries), the outcomes of resuscitation have remained both disappointing and largely unchanged for 40 years (Stiell et al, 2004). This phenomenon has been the subject of sociological analysis in the seminal work by Timmermans (1999) which he accurately titled "Sudden Death and the Myth of Cardio-Pulmonary Resuscitation". In this paper I will analyse, using two case studies based on the resuscitation literature, one of the strategies that the resuscitation community uses to deal with this problem of its continuing failure. This strategy is the attempt to replace human beings, seen by the resuscitation community as fallible, with machines constructed as 'reliable', even though the science that this community values so highly suggest that they are not.

The resuscitation community

I use this term as a shorthand for a grouping of individuals and organisations, all having an interest in resuscitation. The resuscitation community in the UK will be used as a model to delineate the make-up of this community. It is acknowledged that the resuscitation community will be constituted slightly differently in other countries, but the differences are sufficiently small to be analytically unimportant. Resuscitation does not have the status of being a 'full' medical speciality (like cardiology or neurosurgery) in so far as it is not possible for a doctor to qualify as a specialist in resuscitation. The most powerful actors in this community are physicians, principally anaesthetists and cardiologists. The most significant group in the UK is the Resuscitation Council (UK). This has no statutory existence, but is a charity, which describes itself as

> "a group of medical practitioners from a variety of specialities who shared an interest in, and concern for, the subject of resuscitation. The objective of the Council is to facilitate education of both lay and healthcare professional members of the population in the most effective methods of resuscitation appropriate to their needs." (Resuscitation Council 2008)

As this statement suggests the Resuscitation Council is dominated by doctors, though other professional (nurses and paramedics) and non-professional groups (first aid trainers) are involved in its work. The Resuscitation Council publishes the main scientific journal in the field, *Resuscitation*.

Another group of participants in the resuscitation community are the first-aid charities like St. John Ambulance and the Red Cross, as well as charities such as the British Heart Foundation which fund research and interventions in resuscitation. A key source of finance, as well as being influential participants in the resuscitation community, are the companies who manufacture resuscitation equipment. Finally there are individuals; academic researchers and clinicians (again, usually doctors) who take in an interest in, or responsibility for, resuscitation. All UK hospitals are required to have a nominated lead clinician for resuscitation, supported by a resuscitation committee.

Actor Network Theory

Actor Network Theory (ANT) will be used as the main theoretical basis for this paper. This is because it treats human and non-human actants symmetrically, which is a key consideration when analysing a situation where humans and machines are so closely entwined, and where some agents are trying to shift the nature of this human-machine relationship. ANT is generally agreed to arise from the work of (inter alia) Law (1986), Callon (1986) and Latour (1987). As an approach it seeks to understand processes of technological change or innovation. It is seen as being part of a wider group of approaches known at Science and Technology Studies, though some authors (Collins and Yearley 1992) disagree on this point. As its name suggests ANT focuses on a network of actors, organisations and technologies, though its definition of what a network consists of is different from the general usage of the term (Latour 1996). I will consider two case studies where these processes (of movement in human-machine relations) can be shown to be at work, and then draw some more general conclusions from them

Case Study 1: Mechanical Chest Compression

Modern cardiopulmonary resuscitation is conventionally dated to 1960 when Kouwenhoven, Jude and Knickerbocker (1960) published their research on closed-chest cardiac massage. Hitherto, cardiac massage had only been possible in the operating theatre. However, almost as soon as closed chest cardiac massage was developed, concern about the ability of people to do it ‘properly’ appears in the medical literature. Don Michael et al (1962) described closed chest massage as “an exhausting procedure calling for several changes of operator and wasteful of the energies of specialised personnel” (p. 560). This problem continues to concern the resuscitation community to this day (for example Lucia et al, 1999; Ashton et al, 2002). By contrast, concern was also expressed that the patient would be physically hurt by over-enthusiastic chest compression, for instance by breaking ribs (Tambascia, 1965), and this concern continues (Smekal et al, 2009).

A variant of this concern about people’s perceived inability to do resuscitation properly is the comparatively long-lived controversy (in the UK, at least) about whether lay people (as opposed to doctors) should be trained to do chest compressions. A review of a first aid book in the British Medical Journal in 1975 says, “Heart compression (closed chest cardiac massage) has been omitted from this book. We think that it is a technique which is too difficult and potentially dangerous for the basically trained first-aider” (British Medical Journal, 1975, p.5). Despite the scepticism expressed by Harley (1966), Mackenzie et al (1964), and Nayak (1964), manual chest compression was accepted fairly rapidly as a technique for doctors. It took much longer for it to be universally accepted as part of the process of resuscitation if it was to be performed by lay people. The resuscitation community has thus had long-standing concerns about how chest compression is performed by people, especially lay people. These are that they may either do it too hard, not hard enough[1], with improper technique, or that they will get tired. Through publications, both research and editorial, a claim is thus being advanced by the resuscitation community. This is that human beings cannot be relied upon to do chest compression adequately – in ANT terms, a problematization. The next stage of the claim is that a mechanical alternative to fallible humans can be constructed.

Since the 1960s the resuscitation community has devoted a significant effort to the development of alternative to human beings performing chest compressions. The history (Harrison-Paul, 2007) of the attempts (and successive failures) to develop a machine that can do this will be discussed in detail, as there has been a remarkable persistence with a technology that has never met the expectations placed upon it. The earliest example in the literature is the ‘electro-pneumatic’ machine designed by Harkins and Bramson (1961). They say, “The machine has been used on patients and has been found to be both efficacious both as a resuscitator and as an assistor. The results of the clinical trials will form the subject of a subsequent communication”. Though no subsequent report appeared, Dotter, Straube and Strain (1961) did report a test of their device. Somewhat laconically, they say that ‘inexperience with, or limitations of, the methods employed’ (Dotter, Straube and Strain, 1961, p. 431) were

[1] A force of 100-125 pounds is recommended for effective chest compression in CPR. Geddes et al (2007) found that many of their subjects used too much or too little force.

responsible for the multiple rib fractures found post mortem. From the descriptions of both of these devices, they seem to be 'home-made', cobbled together by interested physicians and technicians out of parts that would have been easily available in the hospital. They worked by an electric pump producing compressed air, which drove a plunger onto the patient's chest. The early interest this technology generated from commercial corporations can be seen from their involvement in the devices developed by Nachlas and Siedband (1962), Warltier (1963), Birch et al (1962), and Bailey, Browse and Keating (1964).

The first reported evidence of any practical difficulties were encountered in the usage of these machines can be gleaned from Safar and Harris (1963) who conclude that "the time spent in obtaining, applying and adjusting the machine precludes its use at the start of the resuscitation" (p.587). By 1965 Nachlas and Siedband (1965) were aware of "five commercially available mechanical units" and remark on the "superiority" of their device over the others that were available at that time, as do Pearson, Navarro and Redding (1966). Tambascia (1965) concentrates principally on the fact that his device did not appear to damage any of the patients it was used on (in terms of broken ribs or injuries to internal organs).

The only machine to survive from the 1960s to this day is the Michigan Instruments "Thumper", originally introduced in 1965 (Kern et al, 1987). It presents an interesting case, as it does not appear to be noticeably different (technologically) or in terms of effectiveness from the other devices that appear to have fallen by the wayside at this point. Its survival can be explained, at least in part, by the much more energetic marketing and promotion of the device, though it has never come into widespread use. While other developers appear to have published an account of their device in medical journals and not promoted it otherwise, Michigan Instruments have always advertised the Thumper, and demonstrated it at medical conferences. After the flurry of activity in the years 1961-1966, there is then nothing reported in the literature until the 1970s, when a review in "Health Devices" (External Cardiac Compressors, 1973) shows that only four machines were available by that time. Of these four, two were operated by the use of a lever and two were powered by compressed oxygen. The review is largely critical, and suggests that these devices are only effective in the hands of well-trained staff. A similar conclusion is reached in the Standards for Cardiopulmonary Resuscitation and Emergency Cardiac Care (American Heart Association Committee on Cardiopulmonary Resuscitation and Emergency Cardiac Care 1974).

A newer set of guidelines (American Heart Association Committee on Cardiopulmonary Resuscitation and Emergency Cardiac Care 1980) refers to mechanical chest compression, but again imply that they were not then in widespread use. However, interest in mechanical CPR undergoes something of a revival in the mid-1980s (Halperin et al, 1986). This manifestation of the technology is slightly different, in so far as it consists of a gas-powered inflatable 'vest'. This produced chest compression by repeated inflation and deflation. It is striking how Halperin et al report it with all the enthusiasm found in the 1960s, though their research only published data from studies on dogs. A version of this technology continues to be marketed (Timmerman et al, 2004). However, these devices did not come into widespread use. There is another revival of interest in mechanical chest compression in the 1990s. Bizarrely, this followed reports of a successful resuscitation using a toilet plunger (Lurie, Lindo & Chin 1990). This leads to yet another iteration of the technology, this time called the Active Compression-Decompression device (Cohen et al, 1992). The crucial difference in this variant of the technology is that, using a "sucker", the machine pulls the patient's chest upwards prior to compressing it down. Again, the findings from the research studies carried out were unpersuasive to the resuscitation community (Halperin & Weisfeldt, 1992) and the device was not extensively used.

The most recent iteration of this technology is the Lund University Cardiopulmonary Assist System (LUCAS) (Steen et al, 2002). It has been widely adopted by ambulance services in the UK[2], Sweden (Englund & Kongstad 2006) and Germany. According to an internal document from Jolife AB (Jolife AB 2006) who manufacture the LUCAS, 486 units were sold in Europe in 2005, and regulatory approval gained in the EU, Australia and New Zealand. Despite its widespread adoption, the research evidence, of the type favoured by the resuscitation community, is unimpressive. The study by Steen et al (2005) shows a 30-day survival of only 25%, even in patients who had the most treatable kind of heart attack (ventricular fibrillation), and were resuscitated quickly. A wider review (Deakin, 2006) covering the LUCAS and other devices is unconvinced of their benefits. This view is supported by the Joint Royal Colleges Ambulance Liaison Committee (JRCALC) in the UK (the main source of medical advice to ambulance services) who say

> "Given the current evidence we can only conclude that it [the LUCAS] is still an experimental device with unknown effectiveness over manual methods of CPR until and unless evidence can be shown for overall benefit, the ambulance service has been advised … to discourage further use outside properly randomized trials" (JRCALC, 2006, p.1).

The British Heart Foundation has adopted similar policy advice (British Heart Foundation 2007).

Ironically, given that the main motive for the use of mechanical chest compression is the perceived fallibility of human beings, there are case reports of injury attributed to LUCAS

[2] In the UK, it has been implemented by several ambulance services, including Staffordshire, Sussex, Wales and South Western, and trialled by others, including London

(Rose, Cooke and Davis 2008). It may be that this iteration of mechanical chest compression is about to fail again.

What can be seen happening with this history is that a component of the technology of mechanical chest compression has been black-boxed (Latour, 1987). In this case, it is the idea of mechanical chest compression, or, in terms of the components of the device, the piston which delivers the force to the patient's chest. What has successively gone back to the laboratory (in Latour's terms) is how the compression is driven. This has ranged from the simple mechanical use of a lever to amplify human effort, thorough electric motors, pneumatic devices, vests inflated by gas to the current quite complex technology of the LUCAS.

Why did mechanical chest compression fail?

This question implies another question: what would count as success, and for whom? The measure of success in resuscitation appears clear; it is lives saved. However, this is not as simple as it might appear. Even within the resuscitation literature many different "scientific" measures of success are used. They include the return of circulation, arriving at the hospital alive, leaving the emergency department alive, leaving the hospital alive and leaving the hospital alive and healthy. As can be seen from this (incomplete) list these outcomes differ considerably. Nonetheless, the main problem of resuscitation medicine's overall lack of success persists. No matter how it is measured, survival has not improved much since the arrival of CPR in the 1960s (Stiell et al, 2004). Mechanical chest compression is merely one 'failed' technology amongst several that have been tried and failed. What is more analytically important is the persistence with this innovation (and others) over a long period of time, driven by the cultural imperative of saving lives (Sudnow, 1967; Timmermans, 1999; Collins and Pinch, 2005). The commitment to this technology can be gauged by an editorial in the journal Resuscitation (Jacobs, 2009). Despite commenting on four recent studies which apparently show mechanical chest compression to be either ineffective or positively dangerous (Tomte et al, 2009; Axelsson et al, 2009; Smekal et al, 2009; de Rooij et al, 2009), Jacobs calls for more, larger studies of mechanical chest compression otherwise "the likelihood of demonstrating clinical efficacy of mechanical chest compression devices is minimal" (p.1094). The possibility that it might never be effective is not discussed.

Mechanical chest compression was a disorderly ally. The proponents of mechanical chest compression developed a script (Akrich, 1992) for the rest of the community to be enrolled in its use. In the 1960s and 1970s the initial problematization was not wholly taken up by all members of the resuscitation community; some persisted in thinking that mechanical chest compression was not a practical or effective solution. Mechanical chest compression has never enrolled sufficient allies. The community claims that the problem is the subscription of the human actors. Therefore it constantly changes the inscriptions and the prescriptions to enrol them (Lehoux, Sicotte and Denis, 1999).

Case Study 2: The Automatic External Defibrillator in hospital

Even when resuscitation is under much closer medical control in the hospital, the same dissatisfaction with fallible human beings exists. Though outcomes for in-hospital resuscitation are generally better than for out-of-hospital (Schneider, Nelson and Brown, 1993; de Vreede-Swagemakers et al, 1997), they are still thought to be less than optimal. Again, the key problem is seen as being the human actors, and a technological solution is proposed. While the ways in which resuscitation is organised vary from hospital to hospital, and over time, they have some important features in common. In the event of a patient collapsing, where a cardiac arrest is a possible cause, resuscitation is supposed to be started by the staff on the ward (usually the nurses). A more recent development is that, as well as initiating basic resuscitation (mouth-to-mouth and chest compressions), nurses should initiate the use of the defibrillator[3] available on most wards. Nurse-initiated defibrillation is considered to be desirable as nurses are likely to be the first professional staff to be aware that a patient has collapsed, and has been shown to be as effective as defibrillation initiated by physicians (Coady, 1999). At the same time a specialist cardiac arrest team is called, via pagers. When they arrive they take over resuscitation.

In resuscitation, time has been shown to be of the essence (e.g. Colquhoun et al, 2008, though the principle is well established in resuscitation medicine). Delay in CPR, especially delay in defibrillation is strongly associated with poor outcomes (Steen et al, 2003). Within the resuscitation community, attention has turned to possible delay by ward nurses in initiating resuscitation (specifically defibrillation) as the root cause of delay. This delay in defibrillation has been shown to occur with in-hospital arrests (Skrifvars et al, 2007; Herlitz et al, 2005). A crucial paper is Cusnir et al (2004) who suggest several reasons for delay including: time to recognition of cardiac arrest, awaiting the arrival of a designated “emergency team” to attempt defibrillation, and ultimately attaching a device capable of detecting the cardiac rhythm and providing appropriate therapy. What these hypotheses (and Cusnir et al provide no empirical

[3] Defibrillation is the treatment of ventricular fibrillation, one of the common causes of a cardiac arrest, with an electric shock.

evidence for them) have in common is that they are all predicated on the fallibility of the human actors involved and no alternative explanations are offered. Cusnir et al go on to say that "personnel responding may be intimidated by the use of defibrillation and may delay their response because of self-doubt" (p.183). In one of the few studies that attempted, empirically, to measure this phenomenon, a reluctance to initiate defibrillation was found in Japanese nurses by Suzuki, Hori and Kobayashi (2004). Conversely, Kyller and Johnstone (2005) found that nurses (from non-critical care areas) were enthusiastic about taking on defibrillation as part of their role.

Faced with this perceived reluctance or inability of nurses to initiate defibrillation, the resuscitation community has once again sought a technological solution. This is the introduction, in hospital, of the Automatic External Defibrillator (AED), a device originally intended for use by lay people in non-clinical areas (Diack et al, 1979, Liddle et al, 2003). The AED differs from a conventional hospital defibrillator in two main respects. Firstly, it does not give the user any of the information that it collects about the patient's heart. The conventional hospital defibrillator gives detailed information about the types and patterns of electrical activity that it detects in the heart, which the user then interprets. Secondly, the AED takes the decision, using an application of Artificial Intelligence whether to deliver a shock, and if so, what size of shock (measured in joules) to administer. The conventional hospital defibrillator allows the users to determine whether a shock is necessary, and what size of shock to deliver. Depending on its configuration, the AED may advise a shock (usually audibly), and then direct the user to push a button, or it may control the whole process up to and including the delivery of the shock itself, merely warning the user to stand clear. The AED is, both literally and metaphorically, a "black box" (Latour 1999).

Thus, the intention of the resuscitation community is to reduce the professional discretion of nurses, who are thought to be the cause of delay in defibrillation, by delegating decision making to a machine, the AED. This approach has been reported in the literature by Destro et al (1996) and Cusnir et al (2004). In the National Health Service (NHS) in the UK, the AED has now been widely implemented in hospitals[4]. The wider use of AEDs was recommended to the NHS National Patient Safety Agency in a report (Lilford, Branch, Bentham et al, 2005). In one NHS hospital, the introduction of the AED across all non-critical care wards[5] has been undertaken explicitly in order to speed up defibrillation. This is as a result of audits which

[4] For example, Heart of England NHS Trust, Doncaster and Bassetlaw Hospitals NHS Trust, Dartford and Gravesham NHS Trust, Trafford Healthcare NHS Trust, Newcastle upon Tyne Hospitals NHS Foundation Trust, Southampton University Hospitals NHS Trust. All of these organisations explicitly cover the use of the AED in their published resuscitation policies.

[5] Hospital wards other than intensive care, coronary care and high dependency

showed delays in defibrillation. These delays are attributed (by the hospital) to nurses being unwilling or unable to initiate defibrillation (Eyre 2007).

Laws, Zeitz and Fiedler (2004) were unable to establish from the available evidence that use of AED in hospital demonstrably increased survival from cardiac arrest. This was confirmed by Weil and Fries (2005) who say "there has as yet been no secure evidence that automated external defibrillators have had a favourable impact on in-hospital cardiopulmonary resuscitation when used on infrequent occasions by first responders" (p.2825). Mason (2004) is equally sceptical about the benefits of using AED in hospital. However, concern still persists in the resuscitation literature that defibrillation is being delayed. Kenward, Castle and Hodgetts (2002), say that "there is clearly a need for a widespread change in philosophy as well as equipment. Simply introducing AEDs may not be sufficient to improve survival". This is confirmed by Dwyer, Williams and Mummery (2007), again suggesting that the weak point in the 'chain of survival' is assumed to be the human actors, who need to be 'improved', despite the evidence to the contrary from, for instance, Kyller and Johnstone (2005).

The next stage of this ongoing process to re-order this network of humans and machines is the development of defibrillators with voice recorders, for example the Philips HeartStart FR2+ (Philips 2008). This is so that what is said by the participants in a resuscitation attempt can be monitored. This is a further attempt to monitor and control the humans involved in resuscitation. It is seen by the resuscitation community as a development of the 'Utstein' (Cummins et al, 1991) process of collecting standardised data about resuscitation attempts. Saxon (2008) proposes an even more technologically complex solution:

> "One can imagine placing simple telemetry electrodes on all high-risk patients and wirelessly transmitting continuous ECG data to a computer and alarm station. … The centralized computer would continuously analyze these data with the use of automated algorithms. If ventricular tachycardia or ventricular fibrillation was detected, an alarm would be activated outside the patient's room or at the nursing station. Nurses could also be alerted directly with the use of portable communication devices." (p. 78)

Thus, nurses would lose the responsibility for recognising a heart attack, as well as for initiating treatment.

Discussion

The problem of resuscitation (that is, its disappointing lack of success over a long period of time) has effectively been redefined by the resuscitation community, not as a fundamental weakness of the whole project, or as an inevitable consequence of human mortality, but instead as a 'fixable' shortcoming of the human actors involved in resuscitation attempts, which can be addressed by new devices. This process is an attempt to stabilise a network with 'reliable' devices which can substitute for 'unreliable' human beings, and thus make networks more robust and permanent. One of the reasons why an Actor Network Theory approach has been taken in this paper is that it makes the analysis of agency by human and non-human actors possible. Both mechanical chest compression and AED are considered by the resuscitation community to exhibit a kind of agency. The more recent devices in mechanical chest compression (notably LUCAS) decide how hard to push, and how many times. The AED decides whether to shock and at what power. Both of these activities were formerly undertaken by human beings. Thus the resuscitation community can be said to have delegated actions to these machines, by introducing these new actants into the network. A further benefit of Actor Network Theory in this case is that it treats humans and machines symmetrically. Resuscitation appears to be a context where humans and machines are treated as interchangeable. The resuscitation community is trying to move the agency away from the (fallible) humans to the more reliable machines "to substitute for the unreliable humans a delegated non-human character" (Latour, 1992, p.228).

Both mechanical chest compression and the AED inscribe (Akrich, 1992) certain actions; while they still have to be used by humans, the range of actions available to those humans has been reduced. Only those actions which are permitted by the machines are now possible. The resuscitation community, principally doctors, seeks to better control the messy, contingent, and usually unsuccessful process of resuscitation. One of the ways it does this is by substituting machines, which can embody scripts for their use, for human beings who are perceived as unpredictable and unreliable. In the case of resuscitation, it is doctors (actors) who are trying to create a new network, a machine-human hybrid, by introducing actants (mechanical chest compression and the AED) into the process. The resuscitation community (not wholly successfully in either the case of AED or mechanical chest compression) is attempting to 'black-box' (Latour, 1987) the actors (both human and non-human). The attempt is to align them with the inscriptions inherent in the AED or LUCAS. There is then less space for the human agents to manoeuvre. The development of the AED panopticon (Saxon, 2008), the most recent development in the use of AED in hospital, is only the next move in this process.

Like the metered dose inhaler, the AED and mechanical chest compression are "standing in for biomedical control" (Prout, 1996, p.206). The substitution of the AED for human beings taking decisions about defibrillation is analogous with his analysis of the introduction of the "spacer" in the actor-network of the metered dose inhaler. When the human beings have shown themselves to be "fallible", the machine is modified. This is analogous with Wetmore's (2004) analysis of debates about automobile safety in the USA. Like the automobile safety agencies, the resuscitation community believe that machines will be more "obedient and reliable" (Wetmore, 2004, p.377) than people.

Conclusion

Resuscitation is performed by a network of machines and humans; what the resuscitation community is trying to do is change the balance in this hybrid. The case studies analysed show the attempts to change the balance in the networks in favour of "infallible" machines and away from "fallible" humans, despite the continued fallibility of the machines. Both devices have actions delegated to them, and thus impose certain prescriptions on the human actants in the network. A conceptualisation of human beings as weak and fallible is inscribed in both these devices. The resuscitation community persists with this strategy because of their continued failure to improve outcomes, over nearly 50 years of trying, and because machines allow the influential members of the community to retain a higher degree of control over the processes of resuscitation.

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