

Nurses' Use of Technology: Strategies Beyond Dependency

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Abstract

The aim of this thesis is to explore nurses' understanding of technology in the intensive care unit. The study brings together empirical data gathered from nurses' practice in the ICU environment, along with theoretical insights from science and technology studies, to illuminate how nurses' understanding informs their use of technology in their care activities. The empirical data was gathered through intensive fieldwork over a period of 5 months in an ICU department within a large teaching hospital. In addition, recorded in-depth interviews were carried out with ICU nursing staff. The interviews uncover themes such as nurses' practice with technology; nurses' ambivalence around the use of technology in relation to patient care; and nursing identity and professional status. Current theories of technological determinism, social essentialism and technology-in-practice within science and technology studies are examined for their usefulness in illuminating the world of ICU nursing research. In particular, Actor-Network Theory, as an example of technology-in-practice, is utilised as a theoretical lens to explore the contingent nature of social and technological relations on the ICU, where nurses' understanding of technology emerges as an effect of multiple associations between human and non-human actors. The thesis informs existing research by offering further empirical insight into the ICU world through in depth analysis of the semiological and material qualities of technology in the ICU, and develops a number of conceptual themes such as 'balancing patients,' 'chasing numbers' and the 'technology vigil' to frame nurses' understanding of technology. The study also adds insight into the construction of nursing identity, suggesting it is an emergent property of nurses' interactions with technology. The thesis concludes by indicating that knowledge of how nurses understand, use and frame their identity in relation to technology can inform current research into technology adoption and diffusion in healthcare environments.

Keywords: *Strategies Beyond Dependency, Nurses' Understanding, Health Technology, Intensive Care Unit*

1.0 INTRODUCTION

In the previous chapter, I discussed and presented findings from interviews, which, I argued, revealed the 'determining' nature of technology on the meanings nurses give to their practice. I also indicated that determining forces of technology could be witnessed in the dependency nurses placed on health devices in order for them to carry out their duties as ICU nurses. In using the idea of nurses' 'dependency' on technology as a stand in for classic notions of 'determinism,' I want to insist that under the auspices of ANT, capturing the notion of determinism in the actions of nurses in interactions with technology was in fact an effect of socio-technical networks. However, by allowing nurses' (determined) epistemological insights to be explained as an outcome of networks, ensures a less reductive summation of nursing practices as wholly dependent on technology. It may seem, at times, that nurses are in thrall to technology; that their every action is calculated and prescribed by the devices which enable them to carry out the ICU nursing. However, the minute to minute practical 'reality' of ICU practice reveals a more dynamic and shifting set of affairs, where dependency upon technology can shift to where nurses' moral practice plays an decisive part in shaping and reordering the semiotic meaning and purpose of particular health technology.

For the researcher, it would be easy to explain away all nurses' actions through this dependency on technology, after all in an environment so diffuse with technology a great deal of what counts as ICU nursing involves interplay with one computer interface or another. Every meaning placed on activity could be filtered through the lens of determinism. Taking up this epistemological position, however comforting for analysis, would neglect the daunting fact (for researchers) that socio-technical interaction is deeply more dynamic and changing and indeed emergent in other directions, than reducing matters to the single explanation of technological determinism.

Thus in this chapter I will explore those points in the network of actants when the total effect of techno-human interaction suggests that nurses are involved in socially shaping the technology. That is to say, what is comprehended in nurses' practice, at these points in the network, can be explained through the outcome effects of technological and human networks. By continuing with this model I hope to capture the dynamic and fluid quality of life and work in ICU. In particular the following material will demonstrate that part of the techno-human axis best described as the social shaping of technology. By exploring the range of data which emphasises a social shaping character I still wish to hold onto the over-arching viewpoint that the quality of the interaction, which is described here, is an effect of an array of interactions concerning nurses, clinicians, patients and technology. In each case of actant interplay there resides a certain subjective ambivalence to the outcome. I mean by this that all actants play their

part in constructing the milieu, however the intentionality of actants are not necessarily intently directed to defined teleological ends, i.e. outcomes explicitly defined at the commencement of interaction. Indeed ANT eschews any form of prior framework of socio-technical action. Anything resembling forms, or structures, or indeed agency, is in fact the outcome of network interaction. Approaching the framing of action in this way opens space for a potentially novel form of status relationships to emerge between nurses and medical staff in interaction with ICU technology.

Emphasising creativity and dynamism in the network does not address the fact that there exists certain ‘fixity’ or structuring of actions and procedures across time. For ANT the constant performative nature of tasks and duties encompassing the materiality of technological devices ensures that actions are reproduced. In so far as the technology continues to be ‘useful’ in reproducing the same results over time, nurses will remain, along with other translated actants in the networks. It is then, the constant repetition of nursing tasks (performativity) around medical devices, which ensures the recursive practice of ICU nursing. Returning to the focus of this chapter, I will pay attention to how nurses might utilise technological resources in performing ICU care to achieve desired outcomes. The emphasis will be on how technology is used beyond its technological affordances (Hutchby, 2001) to achieve care outcomes. In summary, what will be emphasised in the following sections is how nurses are able to bring together a collective of actants, and shape these heterogeneous elements for particular outcomes - vis-a-vis network effects. The first section will present findings indicating that knowledge of the patient, i.e. observations gathered through the monitoring technology, allows nurses to gain a level of status equality between doctors and nurses, at least in terms of knowledge-based decision making and patient advocacy. Following this, the findings will explore how nurses use technology in their interactions with patients’ families and relatives; particularly in moments of crisis and death. The third section explores ways in which nurses will manipulate technology in response to wider cultural matters. In each of the episodes explored, it will be suggested that nurses in their use of technology are shaping it to produce effects that go beyond the immediate medical purposes of devices, to play a material role in social interactions.

2.0 LITERATURE REVIEW

2.1 Nurses’ and Doctors’ Technological Relationality

It is perhaps a given fact of hospital culture that the medical staff, which includes junior doctors through to consultants, hold a degree of status above that of nurses in the hospital hierarchy. Without necessarily rehearsing the source of this differential in education, gender- historically at least (Keddy et al., 1986), there is a certain acceptance that when hospital nurses consider their status position with regard to hospital doctors, they display open deference aligned to expected cultural practices. For the most part such deference to the greater knowledge and responsibility of doctors on ICU was acknowledged among interviewed nurses. *Mn03, male nurse*: “Our consultants are fantastic have a vast knowledge and I’m happy to defer to their management decisions.” In this next segment, the nurse indicates that beyond practical knowledge, doctors appear to think at a higher level. *Fn14, female nurse*: “Doctors are a lot more knowledgeable, and they often have ideas that you wouldn’t have thought about”. Both statements above- there were others that spoke with the same professional deferment - conjure up the ‘instinctive’ understanding of nurses, which culturally assign nurses and doctors/consultants to the naturalised hierarchy of hospital life. Manias and Street (2001a, 2001b), in their ethnographic work in the critical care setting, point out in their findings that nurses are prone to passivity in their use of patient information to gain knowledge status between themselves and medical colleagues. Describing consultants’ views of the nursing process as ‘house-keeping’, the authors describe the marginalisation of highly technical nursing knowledge during ward ‘rounds’ as doctors’ strategic efforts to minimise the input from nurses.

These findings share similarities with the views among the ICU nurses interviewed, at least with regard to individual nurse’s articulation of deferential language during interviews. However, this use of deferential modes of speaking about doctors is balanced with a narrative where nurses construct their status position as equally collaborative in care interventions. Allen (1997) has described these patterns of activity where the nursing-medical decision-making boundary is viewed as a ‘negotiated order’; revealing the contextual and dynamic nature of interaction. My analysis also indicates that a more nuanced interaction was taking place among nurses and doctors, particularly in ways that technological knowledge was used as an intermediary in the sharing of information about patients (Tjora, 2000). Moreover, it is indicated that nurses, because of their proximity and immersed use of medical technology, come to hold a great amount of information on patients, and use this knowledge to negotiate the hierarchical order between nurses and doctors. This held knowledge has a double effect: it promotes nurses as prime advocates for the patient’s care regime, while at the same time blurring the decision-making as a status indicator between medical and nursing staff.

In this chapter I will describe how nurses accrue this form of power, developing the idea that it manifests as part of the technological environment in which they spend a great deal of their work routines. The following passage comes from my observational notes, I recorded many such encounters around the patients’ bed space; this one is

typical of others. The purpose of the extract is to show the reasonably consistent patterning of interaction between nurses and doctors:

Field notes 19/11/2008: I'm watching the nurse and the doctor interact around the patient. The doctor is standing at the desk at the bottom of the bed. He is scanning the records looking up and talking to the nurse who stands at the side of the bed next to a ventilation machine. Although I can't hear the conversation I notice the nurse is manipulating the touch-screen interface on the ventilator. While this interchange of talk carries on, the nurse remains at the device and the doctor at the desk. After scanning the patient's observation sheet the doctor moves the two metres or so towards the nurse and the machine, he looks intently at the screen while the male nurse continues to talk. Throughout the encounter, the nurse has remained the closest to the ventilator. After approximately three minutes the doctor leaves the patients' bay, and in the time I have observed this episode, the nurse has remained the nearest in proximity to the device.

During observations I recorded numerous episodes in which the immediate spaces surrounding the medical devices were occupied by nurses when interacting with medical staff. I considered in my observations during similar encounters that nurses' near proximity to the patient and technology in use was an enactment of nursing space. Moreover, this space around the bed is the space of information gathering: it is here that nurses attend not only to observations directly pertaining to the patient's body, but also the information coming from the bank of monitoring and interacting technologies. The amount of technology used depends on the patient's care requirements, nevertheless, when devices are connected to the patient, their immediacy to the patient is set in accordance with the limits of the device for example, any peripheral tubing attached. These are the exigencies of the space, and at the same time the major focal point of nurses' work environment. The typical ICU bed space on this particular unit is an environment replete with medical technology. It is also a space that nurses have to negotiate when performing their care activity. This domain of technological immersion informs nurses' attitude in relation to shared information with medical staff. Nurses, through the deep immersion in this techno-human space, believe themselves to have greater knowledge of the patient's care regime, and the moment-by-moment understanding of the patient's illness status: *Fn18, female nurse: "I do think because the level of knowledge you have about that patient we know everything. Whether it's in terms of the external, whether you've looked at the wound or the blood results or whether you've looked at the drug chart...the technology gives you that knowledge."*

It is the nurse who carries out all primary care: washing, feeding, and moving the patient. In addition, they are responsible for the proper functioning of all medical devices and technology, which may be attached to the patient. Nurses reported that they have the task of setting up machines after a prescribed medico-technology intervention has been prescribed by the doctor. With a few exceptions, it is nurses who set up and have continued responsibility for calibrating the filtration machines, or ensure the continued function of diffusion devices. These procedures require nurses to relate to ICU nursing duties in a way that places an emphasis on the acquirement of technical skills and know-how. *Mn05, female nurse: "Whereas I suppose the new filtration machines, we're the ones that put the patient on the machine and we're the ones who take the patient off the machine. And we're writing down all the numbers and so on and so forth so I can imagine we're better at troubleshooting issues that come up with it than I suppose the doctors would be."* Nurses' practising technological knowledge as power reveals that power holds a temporal dimension, where the nurse's statement reveals a belief that their knowledge and expertise has priority above that of the surgical specialists dealing with the patient: *Fn18, female nurse: "If you look at for example the surgery team will look from a surgery point of view, they would not know anything about the ventilation; where we would understand. I'm not saying we're doctors but we understand the relationship between the ventilation and the patient, which is slightly more of a priority sometimes than the surgical point of view."* In this following extract, the nurse emphasises the nursing team's knowledge of the ventilation machine, and the timely intervention of that expertise as important in keeping the patient viable to allow other specialists to act on behalf of the patients, while at the same time elevating nurses' perceived professional role.

Fn18, female nurse: "The ventilation machine is the biggest and most common technology we use in intensive care. A lot of specialist teams that aren't associated with intensive care- they have no knowledge of that. If you know that much detail about your patient, you're quite empowered as a nurse..." From the perspective of nurses interviewed, the technical expertise, which assures their mastery over the ICU technologies, extends their domain of knowledge in interaction with medical staff on the ICU: *Mn03, male nurse: "If I'm not happy I will go back and argue my case, but my case is helped if I can make a sensible argument. I don't just go 'write me this'. I say we can change this prescription because my patient is in tachycardia, cold and clammy... I need to give a rationale and I can give a more useful rationale if I understand what's gone wrong with my patient. And the technology lets me do that".* The nurse in the previous extract feels assured that through appropriate application of technologically given knowledge of the patient's condition, he can persuade medical staff to re-assess a particular care regime. He is mindful that any argument for reassessment of treatment is strengthened by nurses' contextual use of technologically derived

information, which in their account has all the weight of empirically derived fact. This is not about nursing as an art, or intuitive feel; this is nursing rationale practiced as a form of science (Dean, 1998). The primacy of knowledge of both technology and patient extends to other forms of situated ordering. It was pointed out by interviewees that of all the health professionals that come into contact with patients in care encounters, they necessarily spend more time with patients. As a standard ratio of one nurse to each patient on a given shift; the intensive and close care relationship gives nurses a greater insight into their care needs. With the proximity of the nursing role as primary carers, nurses come to hold the view of prime advocates for patients.

Fn09, female nurse: "I think we are quite autonomous in our practice for that one patient for a 12-hour shift or a seven-hour shift or whatever we are working. And we can initiate therapies, obviously working with the doctors; they are very of receptive to our ideas. If we think something needs doing, they'll agree 'let's go ahead with it'. We'll advocate for the patient as well. We need to act in their best interest. We need to speak up if we think some treatment will not benefit them." Mn03, male nurse: "I not saying that I know better than the doctors, but I do think because I'm spending more time with the patient I am the best person to relay changes in their status condition. At the end of the day our consultants are fantastic; have a vast knowledge and I'm happy to defer to their management decisions, but I have to act as advocate for the patient and I'm in a very good position to do that, because I monitor them closely."

In the previous comments, a number of things need to be unpacked in order to reach the core effect of the network. I wish to suggest that nurses are using the technology at one level to relay information on the patient to medical staff. However, what interests me in my analysis, is that while they may be carrying out routine tasks of providing details of the patient's status, they are also using the *affordances* (Hutchby, 2001) of technology, beyond instrumental utility, to manage their status relationship with consultants. In this sense the nurses become the heterogeneous engineers, bringing together an array of actants producing a network effect of medical competence, professional judgement and autonomy, all of which work to shift the relations of power between nursing and medical staff. In this next extract, the nurse presses the point that her skill and know-how over technological application, puts her in a position of strength which allows her to impose direction on the treatment of her patients: *Fn11, female nurse: "The doctors don't know how to use it, but they will tell us how to write a prescription [for the machine's use]. But they wouldn't know how to use the machine." Interviewer: "Is there any time when you've used that knowledge of the machine to argue for a certain treatment for a patient. You use your know-how to argue the point of a treatment?" Fn11, female nurse: "Yes, especially with junior doctors, you're basically telling them what you want them to write down basically." Interviewer: "And you know you're doing that with that particular knowledge to mediate a discussion on the patient's treatment, with people who are ordinarily higher up the hierarchy?" Fn11, female nurse: "yeah."*

Similarly, in response to the question of nurses' autonomy over care decisions, which in other medical settings would be the domain of doctors, nurses in ICU report changing, within certain parameters, the patient's drug administration: *Interviewer: "...Yeah, I was quite surprised how much autonomy nurses have with technology in terms of syringe drives, and how much you might up the doses- you know- Different parameters." Fn06, female nurse: "But we as nurses are making that decision a lot of the time."* What, may be asked, comprises the network of actants that nurses so deftly co-opt for the purpose of effecting professional (i.e. social) relationships? For a start, the medical technology: ventilators, monitors, dialysis, infusion devices, all comprise, in their own way, networks of expert systems. Further actants might include technology training manuals, courses, and the mass of hospital and company personnel, designers and engineers, all of who will be immersed in other networks of their own. Of course the nurse does not marshal all these potential actants, there is no need to. Many of those components, at a distance, will have already been black boxed and configured towards network(s) stability. The technology surrounding the ICU bed is a representation of these far off networks and expert systems, black-boxed, immutable mobiles, which according to Latour (2005) maintain their integrity of purpose, while the network that transports them to their site of operation remains intact. This is how network influence operates: nurses as heterogeneous engineers gain local influence from drawing the forces of networks, which are transmuted through the technology. But what I wish to emphasise is the notion that any influence nurses take from the network by way of resources, also operates as a transmission of symbolic power. What I mean by this is that doctors and others recognise the conjoined representations of ICU nurses, technology, and expertise played out in routine nursing activities. In the circuit of meaning, these semiotic assemblages afford significant power to nurses.

This is demonstrated in nurses' accounts when describing their relationality to doctors: they talk of a working equilibrium of knowledge. However, it needs to be acknowledged that nurses' recourse to network power remains precarious; this is true of all heterogeneous engineering in actant networks. It only takes a weakening in the work of translation, the recruitment and co-opting of actants in the network, for things to disintegrate. Networks need to be maintained and, in the language of ANT, constantly performed in order to stabilise the entities the networks are

producing. I gave an example of this break-down of networks in the previous chapter when a nurse disclosed that a consultant viewed a particular piece of technology as ‘random number generators’. At that moment, the nurse described the vertiginous nature of their care tasks. A form of cognitive dissonance, which I suggest emerges in the momentary breakdown of network integrity. Nurses spoke of the discussions with consultants where their technological expertise allowed them to advocate for changes in their patients’ care regimes. During observations, outlined above, I discerned further use of the symbolic force that nurses are able to utilise when interacting with doctors. It was evident in the positioning of human actants in the space around the bed. The nurses took a position which was proximal to the technology. It was from this position, observed on numerous occasions, that nurses conducted care-focused interaction with consultants. This is not to say medical staff never entered the space, however, the interaction and positions taken up by actors indicate that this space was not the medical personnel’s constant domain of practice, which indeed it was for nurses.

Nurses’ discursive, symbolic, and embodied practices around technology, which are in the extracts presented above, are all forms of practice that are directed towards the social shaping of technology. At these moments, the technology is recruited into the interaction to produce particular social outcomes. I cannot stress strongly enough that this interaction is not intentional, it is not evident to nurses, and they do not talk of their action involving technology in this way. Nevertheless, these interactions do produce particular social outcomes through the material and symbolic relationality of actors in the ICU.

2.2 Nurses’ and Relatives’ Encounters with Technology

The material and symbolic use of technology was divulged in other interactions that take place between nurses and relatives. A predominant area where nurses talked about shaping technology beyond technological affordances is in their dealings with patients’ relatives. The ICU with its complexity of medical technology is a formidable environment for relatives and other visitors. As nurses expressed it, often the array of apparatus surrounding their loved-one becomes the focus of attention for relatives. For a patient who might be fully sedated throughout their stay in the ICU, visiting kin are unable to talk to the patient to get an understanding of their condition. When patients are unable to communicate, relatives will turn to nurses in the first instances. Nevertheless, what nurses noticed was that when communication between relatives and patients was non-existent, due to patient sedation, relatives focused in on what they perceive the technology was ‘telling’ them through the various beeping noises and visual monitor displays. According to the interview data, nurses felt that in their experience, relatives held an ambivalent perspective on ICU technology. On the one hand, technology added anxiety to relatives’ ICU visits, perceiving parameter alarms or spikes in the rise and fall of electronic traces as an instance of imminent crisis. On the other hand, nurses believed that patients liked the presence of the technology, as it offered evidence of quality care. It seemed that more devices meant better medical attention.

Mn18, female nurse: “Buzzing of an alarm yes that’s a fear for relatives. The alarms and the noises they’re not used to; or the flashing lights they don’t like, but the actual stuff there, they like that.” Here again the symbolic meanings of technology in context come to the fore in relatives’ reading of the symbolic and ‘textual’ effect of the machines i.e. the wonders of modern science and technology. However, relatives do focus their concerns and anxiety when machines report unexpected changes through built in alarms systems. For the most part nurses deal with alarm occurrences as the effect of ‘artefacts’. In this next quote, the nurse explains the occurrence of artefacts in relation to an ECG monitoring: *Mn08, male nurse: “An artefact is interference with whatever the machine is monitoring so like an ECG: the ECG dots are connected to patient’s chest and the chest is covered in muscles so if the patient had muscle twitch or moved it will cause an artefact on the monitor. But it is down to you to recognise that it’s an artefact and not a more serious problem.”* *Office Interviewer: “So the technology doesn’t report that an ‘artefact’ has occurred?”* *Mn08, male nurse: “Well sometimes it does and sometimes it doesn’t. Sometimes it will tell you it’s a dangerous rhythm when you can see it is not. Sometimes it will say the patient is dead when obviously the patient is not dead [laughs].”*

An artefact in ICU language is an adverse reading or an ‘aberration’ as one nurse put it, as a result of an interruption in the connection between patient and monitoring technology e.g. a finger probe for blood/gas monitoring. Artefacts occur when lines leading to and from the patient are kinked, or when the patient’s body makes an adverse movement that is not conducive to the delicate operation of the technology. It could be said then, an artefact is neither directly indicative of the patient’s condition, nor the working condition of the machine, but somehow a disruption in the interaction between the two actants. Nurses’ efforts to understand relatives’ concerns recognise that alarms, beeps, soaring numbers, and unusual traces on monitors are all examples of technology not ‘looking right’. As the next interview extract shows, when adverse technological events occur, relatives’ attention immediately focuses in on these phenomena as a focus for anxiety: *Fn13, female nurse: “[T]he equipment doesn’t look like it should look like but that*

very quickly goes and they [relatives] are quite comforted by that.... Actual physical equipment that's not making a noise and not flashing is very comforting to families."

Realising this point of raised anxiety for relatives and loved-one, the nurse uses a number of strategies that involve manipulating the equipment. This might involve resetting alarms by sourcing the cause in the first place. In some instances where the machine might be alarming excessively, due to constant patient movement or incorrect positioning of the line, the nurse will set the alarm parameters wider. This work is all towards shaping the device in order to make the technology look like it should. That is, quietly going about its task in the background. In ICU nurses' accounts, in the absence of direct communication with their sedated loved-one, relatives are drawn to reading the signs emanating from the technology. When the technology is stable, according to nurses, relatives take it as a sign that the patient is stable, and is a source of assurance. In these moments nurses recognise that relatives are somewhat in awe of ICU technology as the sole agent of life support for their loved-one. However, when problems arise, which destabilise relatives' technological reliance, such as the occurrence of artefacts, nurses are able to gain cachet by sorting technical issues, whilst highlighting to relatives the mechanical fallibility of the device. Importantly, this network of heterogeneous elements: relatives, patients, health technology and nurses, operates in effect through symbols, where relatives read technology stability as patient stability; where nurses' correctives operate symbolically to demonstrate their skills in troubleshooting technical problems. This strategic textual shaping of ICU technology is demonstrated in the following comment: *Mn08, male nurse: "I think the best equipment - I say this to relatives when they go on about life support machines in ICU- and I say the only life support machine in ICU is me. I'm the person controlling all of this stuff, without me this stuff wouldn't do what it's supposed to do."*

The outcome of this semiotic (Law, 2009) strategy works to position nurses as indispensable to the operation of the technology and the continued care of the patient. Nurses in effect position themselves as an obligatory passage point (Callon, 1986b) in the techno-care regimes of patients. This strategic interaction sets nurses up as indispensable to the continuation of the patients' and relatives' relationship in the ICU environment. The quote above presents as an exemplary case from which to argue the point of nursing skill and knowledge as an obligatory passage point of ICU care. Moreover, nurses' ability to form strategically localised networks around care activities that make them indispensable extends to their interaction with medical staff as the nurse in the next extract indicates: *Mn17, male nurse: "We see something's happening and we know through past experience what would fix that, and we often go and get the doctor, say this is what we need and nine times out of ten they say yes fine and agree to it. I guess that because we have that knowledge there is a greater equality."*

In addition, at a later point in the same nurse interview the nurse mentions: *Mn17, male nurse: "We have been empowered through technology." Interviewer: "In a sense how has it empowered nurses?" Mn17, male nurse: "Certainly the stuff we use here empowers nurses, every day we use ventilators, we use things on them and use them to a greater degree than any of the doctors do, apart from maybe the consultants, and when new doctors come onto the unit, you have to teach them how to use a ventilator."* Within the context of nurses' constant ICU bedside vigil, patient observations are amassed. The accrued knowledge of the patient held by nurses serves to obligate those medical staff not familiar with the technology to enter into relationships of knowledge exchange with nurses. To quote an often-used aphorism: knowledge is power, and it is through the ability to exercise power in socio-technical interactions with medical staff that nurses gain role equivalence. Of course, the power dynamics that circulate through the ICU, shaping the context specific interactions between nurses and medical staff as well as patients and relatives, is always on the move, ever-changing by degrees. However, repeated nursing procedures around the materiality of technological infrastructure of the ICU to some extent stabilises forms of activity. This allows nurses through constant performance of specialist procedures (involving technology), usually associated with medical expertise, to view themselves, as one interviewee put it, as 'mini-doctors'.

2.3 Technology and Death in the ICU

I have presented findings which indicate that nurses are network operators who import socially significant practises into their interactions with technology and other actors. The socio-technical interactions that go on in ICU extend into matters of managing with moral sensitivity the death of patients on the unit. Inevitably, handling these episodes coincides with dealing sympathetically with relatives and loved-ones. It is at the passage of dying that nurses, who were interviewed, heightened their accounts to emphasise the personal interaction that is central to the notion of being a nurse. Moreover, it is at the dying vigil where nurses must demonstrate qualities of empathy with others, which goes beyond any expertise with the technology: *Fn13, female nurse: "I think that there's a lot more to being a nurse than just the technology part of it, there's all the interaction with your patient and interaction with relatives and all that sort of thing, which I think comes from the person you are as opposed to being anything you're taught. You can be taught how to treat relatives when their loved one's dying but that doesn't mean you actually know how to do it until you are in that situation and dealing with it."* In the above extract, there is a sense that the nurse's account

wishes to make a division between the skills nurses are taught, which by inference must include technical expertise, and the idea that good nursing is about having the personal grace to deal with difficult situations intuitively. Critically, when nurses discussed the occurrence of patients dying, this modality of nursing came to the fore. What was also discernible in the analysis was that although nurses, when dealing with death, held ambivalence towards the technology, they nevertheless used the technology in socially creative ways to enable the transition from life to death.

I use the notions of nurses' ambivalence towards the technology and their creative social shaping of technology, to suggest that the actions of ICU nursing is about immersion in the environment. It is about being in the world of ICU and also creating that context in the same instance. It is also about embodiment. In a Heideggerian sense, medical technologies become unconsidered and ready-to-hand (Dourish, 2004). Similarly, while nurses go on in this world, each moment continues to the next with a certain un-reflexive passage of action. Thus, when nurses were asked in interview if they shaped technology when caring for patients such as at moments of dying, they had difficulty in conceptualising the idea of technological shaping. Nevertheless, their accounts show that indeed they were applying the technology to particular social ends, or in other words utilising the technology towards its 'social affordances' (Hutchby, 2001). The next extract comes from the nurse who provided the quote above. Whereas in the previous account the nurse rests on the importance of personal interaction when faced with death in the ICU, her following account nevertheless demonstrates the creative use of technology to keep the patient 'alive', as an empathetic response to the relative's need to be at the patient's bedside to bear witness to the moment of death.

Fn13, female nurse: "...[I]it's nice to be able to offer that to families, to be able to...if someone's got a son that's travelling up from London, and he got in his car at 6 o'clock in the morning and we decide at 8 o'clock that there's not a lot more we can really do. So if we can sort of maintain things until he gets there at 10, we're allowing him his opportunity to say his goodbyes, which I think is really important." For the nurses quoted in the next two extracts below there is recognition of the possible different uses of technology surrounding patient care. In the first extract, the nurse begins their account by acknowledging that nursing care (and the application of any technology in that care) is directed in the first instance towards a 'cure'. When those efforts have come to an end, and nothing else in terms of curative medical care can be done for the patient, the emphasis is on affording a comfortable death. At this moment, 'allowing them to die' is signified as a technological management of the life-death transition. *Mn17, male nurse: "The initial direction that you are going in is to try and keep someone alive so that you can make someone better. Then, you find out that you can't make them better so allowing them to die is the obvious choice, but I guess because you can't make the situation better for the patient in that situation, it's better to make the situation better for the relatives because emotionally people want to be there. They want to know that their relative was comfortable."*

In the second passage, the nurse (Fn10) takes up the narrative by exploring the possible procedure of assisting the transition by focusing in on the purpose of the ventilator at this time. To be sure, this is still nursing care for the patient. Nonetheless, both nurses are clear that the technology used is also directed at ensuring a dignified death not only for the patient, but also for relatives who witness it. *Fn10, female nurse: "We use technology in the sense of keeping patients comfortable at their time of death. So they look comfortable for the family etc. by leaving the ventilator on so they're not actually struggling when they're breathing until their heart stops...so we might use the technology in that sense."* It is obvious from the nurse's accounts, that when episodes of life-death transition occur, technology remains an important signifier of patient viability for their relatives. As was mentioned earlier, relatives consider the barrage of technology surrounding and interacting with the patient, to be the absolute focus of life support. Once all matters regarding the patient's condition have been discussed with relatives, and a decision made to allow the patient to die, the focus of attention for relatives still turns to the technology. In the moments of death transition, nurses talk about loved ones being transfixed to the monitor traces, to the sounds and lights of the ventilation machine. Each machine, while still operating, symbolises the living patient and the presence of a loved one still in the world. At these liminal moments between life and death, nurse's accounts show how their shaping of the semiotic 'reading' of the technology, can help relatives move through the life-death transition of their loved one. As is captured in the next interview extract, when so much importance is placed on the technology, the nurses' performative removal of the monitor might cause momentary consternation with relatives. Nonetheless, the symbolic emphasis made of the redundancy of the technology, by the removal of the monitor, is used by the nurse sympathetically to help the relatives focus on the passing away of the patient. *Interviewer: "Do you manage that removal of devices and the time of death as a strategy around relatives' acceptance of the death of their loved one?" Fn09, female nurse: "I usually take them off...I switch the monitor off and put it on the other bed area because you walk in and the family are there and they'll say, 'Are you going to switch that off?...Oh no don't switch it off.' I'm going to switch it off, I've got it out there, because you're looking there [at the monitor etc.]; you're not looking at your loved one. It's not what's going on there, I'll tell you when something's happening on there if he's slowing down or whatever, but you'll need to be with them, not with the monitor."*

As the previous extract demonstrates, machines in the ICU environment are not used wholly in terms of their technological affordances. That is to say, the machines' affordances have gone beyond the direct purpose built into them as part of their designated technological role. Ordinarily, the bio-medical purposes built into monitors, filtration machines and the like; represent a network of heterogeneous elements including expert systems, design teams, electronic components, sales reps, and operation manuals. All of which have been shaped, fixed and 'black-boxed' to operate locally within the ICU with an exact medical purpose. However, and without contradiction to any designed purpose, nurses are 'shaping' the technology, at least symbolically, to allow particular social affordances. Although the ICU nurse remains part of the technology network, and indeed what it means to be an intensive care nurse hinges on circulating within the technology network of heterogeneous elements that make up the ICU, nevertheless, nurses necessarily enter into other networks and associations. At these conjunctions, where networks traverse, accounts show nurses reconfiguring the meanings of the technological environment in response to the wider matter of a patient death and family grief.

Of course death, and the witnessing of a person's death, is a profound social activity that is marked in all world cultures (Howarth, 2007). Even in the technologically bound world of the ICU, nurses are also fellow actants in the network configuration of death observance. As such, shared cultural meanings and action around bearing witness to death binds them to observing the importance of the passage. When the dying process does occur, as it often does in ICU, nurses recognise the relatives' need to say 'goodbye' in ways that mediate the use of technology to allow this to happen. *Interviewer: "Would you say that the purpose of that is to allow that social activity of saying good bye to a loved one?" Fn10, female nurse: "Yes, I suppose we do use technology to manage that situation. So, we'll switch that technology off but I'm still using that technology. I've taken that technology away from the family, but I'm still using it."* It may only be a matter of removing the monitor or turning off a ventilator, nevertheless this performative action of removing the technology holds symbolic significance. Extending beyond the technological use, the machines' semiotic reading is managed in social interaction to prepare relatives for the patient's death. This is an example of medical devices' social affordance, and in such circumstances represents a transgression of technological purpose. The liminal nature of death and its management within the technological regime of the ICU was profoundly demonstrated when nurses' accounts addressed the potential of dying patients as organ donors. Here, nurses struggled with their deontological concern for patient care (Vivian, 2006), and the over use of the technology to keep patients 'alive' in order for organs to remain viable for donation (this being sanctioned by patients and relatives). In the first extract below, the nurse questions the use of the technology to keep the person alive, but justifies prolonged use of the technology by the moral extension of helping others through organ donation. *Mn19, male nurse: "How far do you take that? But we do that when patients are becoming organ donors. That patient is clinically dead but we are using the technology, so those organs can be given to another person. I'm not sure if there is anywhere in the ventilation manual where it would say that."*

Interestingly, the last sentence makes reference to the operation manual for the ventilator. Here the nurse suggests that the use of the ventilator to extend life for the purpose of organ harvesting is not part of the machine's technological affordances as laid out in the manual. There is an insinuation that the ventilator's use in extending the viability of the patient's organs brings into play particular social affordances, which circulate in further heterogeneous alliances that view organ donation as a socially desirable end. Thus, in the next extract, a nursing colleague appears to have no qualms around the prolongment of technological use. This is justified, consequentially, in potentially extending other lives through organ donation. Moreover, the nurse mentions her network interests as a source of enframing bias, which mediates her justification for the extended use of the ventilator. *Fn09, female nurse: "But I think that the equipment is absolutely fabulous. I'm a bit biased because I've got my own interest in it, but with patients who are going for organ donation because we can 'keep them going', [signed in inverted commas] and keep them stable and everything we need to do until surgery is ready for them."* Interpreting the previous two data extracts; the indication is that ICU nursing practice involves using technology besides its bio-medical application in maintaining organ systems. As with other objects, the ICU technology's semiotic qualities allow it to be reshaped, reconfigured symbolically in efforts to build and sustain actor-networks. I give the example above of organ donation. It is clear that this particular network (which has national and international influence) ensures the localised co-opting of nurses into specialist interest groups, who in turn translate and shape the ventilation technology, not only as a device to assist patients to health, but also as a device to ensure the viability of organs before harvesting. The whole business of organ donation is made up of many alliances: patient groups, medical experts, surgical technology to name only a few elements in the network. Nevertheless, my purpose is to show that the institution of organ donation is an effect of local heterogeneous alliances mediated is some part by ICU nurses.

2.4 Ethical Care in the Realm of Technology

When talking about their use of technology in relation to the death of patients in the ICU, throughout their accounts nurses strived to present an ethical dimension to their care practices. For, although death in the ICU was found to be mediated through the manipulation of technology, as the quotes above show, nurses were of the opinion that this did not detract from providing a dignified end for their patients. The notion that ICU nursing could offer a dignified death to patients was framed in the next quote by the respondent emphasising the virtues of nursing care as personal engagement. *Fn13, female nurse: "I think that goes back to the personal nature of nursing. One of the things that I like about ICU is that we can give people a very peaceful and very dignified death. The peacefulness of death that patients get on ICU; I don't think you get in many other places."* In this depiction of ICU nursing, the role that technology plays in affording a dignified death vanishes somewhat. The emphasis rests on a humanist concern for patients. As the nurses state, 'it's going back' to the held ideals of nursing, which in many of the accounts given by ICU nurses equates to a supposed 'Nightingale' model of nursing. Framing the nursing approach to dying patients as one that enables dignity through personal and authentic caring, also acts to position the nurse's ambivalence over technology, as just another tool in their arsenal. This perspective operates not only to neutralise the importance of technology in social events such as dying, but it also acts to lessen the importance of nurses to the heterogeneous engineering activities of translating or shaping the technology towards desirable outcomes, vis-à-vis the portrayal of nurses as naturally and authentically predisposed to promote the dignity of patients.

Understanding nurses' accounts in terms of socio-technical network building, it would appear that pushing medical devices to the 'background,' (at least in terms of framing a set of meanings of what end of life nursing is), positions technology as a network intermediary. That is to say, the technology, along with other elements, is enrolled in the network to building the semiotic reading of nurses as naturalistic care providers, without changing the intended network effects. As the next extract indicates, only on reflection does the nurse recognise the place of technology. *Fn06, female nurse: "You do want to be spending more time focusing on what needs to be done for your patient in terms of meeting their needs; your patient is a priority so you sort of want your equipment to be reliable and not take up as much of your time. As long as it does its job and it's reliable... I actually think in some sense that the technology is blanked out. You don't think about that it's technology that you're using if I'm going to be honest with you I think you're so used to using it, that's the problem that you just forget it's technology."*

Much of what enables ICU nurses to feel that they offer a greater level of care, compared, in their view, to general ward nursing, is due in part to the availability of human and technical resources. However, interviewees added that although ICU nurses have only one patient to care for, the intensity of that care relationship with its constant scrutiny, which is both hands-on and observational, requires the concentration of technology that surrounds the patient. However, as the next extract indicates, having all the technology does not diminish the need to focus on the basics of nursing care. *Interviewer: "How does a nurse in ICU strive to retain the humanist element to the task; that one-to-one bedside manner?" Fn11, female nurse: "I suppose that's when the personal care comes in, when you're doing mouth care; you're talking to the patient. When you're washing them even when they're sedated, you're still talking to the patient. And I suppose you're interacting with their relatives."* I suggested above that when nurses talked about their practice around technology they were busy at work framing their role in ethical terms. It is not however the case that nurses needed to explicitly mention or talk about ethics in practice; it was evident in their accounts that they wanted to be viewed as moral actors. For instance, as a general rule, total reliance on the technology was viewed as problematic.

Focusing solely on the technology was seen as moving nurses' attention away from the patient. There were many instances where nurses admonished themselves when accounts revealed an over reliance on, for example, the monitor, to tell them about the patient. The following quote is an example where the nurse berates herself over attentive focus on the machines: *Fn14, female nurse: "I think I'm very reliant on the technology. Now, that is a bad way of being, because you're supposed to...we're always told not to necessarily rely on technology. You should look at the patient first. You should look at the patient and see how they are."* In a similar vein, interviewees talked about their concerns when technology was used to keep patients alive, when any quality of life was unlikely to be an outcome. ICU nurses mentioned that although they would not have the final say, they would be expected to contribute to the discussions on such matters. In the next extract, the nurse expresses their views on such circumstances and in doing so they highlight the threat to the ethical treatment of patients by prolonging life through medical technology.

Mn17, male nurse: "There comes a point where you have to accept that even with all the technology you are not going to make life better for anybody. Neurosurgeons are definitely offenders, there is a big reluctance to admit often that you can't make a difference to the patient surgically, and often there is a notion that being alive- heart pumping, breathing on a machine, is still better than being dead, which I don't think is true. It's an ethical point but it's one which we have to grapple with. I think that there's often a temptation to keep people alive when necessarily we shouldn't."

As the nurse suggests in the quote above, the possibility of technology to sustain life is not the best way forward for patients in some cases. However, there is a further suggestion that technology's ability to prolongment might be countenanced, when medical staff seek to defer professional failure. It is evident that from the next segment, which followed directly from the one above, that the surgical team's use of medical technology to prolong life is one network configuration nurses are reluctant to enrol upon. *Mn17, male nurse: "The family have to be here while we continue to do something with no quality outcome possible. It's not good, and we are very vocal about this, and we pride ourselves on being advocates for people when they cannot speak up for themselves."* It seems that the nurse is at work building an account in which they viewed the surgical team's decision as potentially unethical. It cannot be discounted that nurses' accounts in the context of the research interview are formed for the purpose of constructing moral distance between medical and nursing staff in order to place the deliberations and actions of nurses in the best possible light (Allen, 2001). Interestingly, although the individual in the quote above appears to talk for all nurses on the ICU when they state, "we are very vocal about this"; it is evident that such a blanket response to the use of technology: that it is a bad thing when used to prolong patients' lives, does not relate to all nurses in all circumstances. As I have reported earlier in this section nurses will go along with decisions that maintain dying patients on technology, while relatives have the opportunity to say their goodbyes. Similarly, nurses with professional interest in organ donation justify extending donor patients' viability on life support technology, while waiting for the availability of the organ donation team.

It would however be wrong to put these actions, which on the surface resemble similar use of technology to the neurosurgical team, down to a level of hypocrisy on the part of nurses; where technology use in one situation receives opprobrium, and in another is morally acceptable. What can be said is that a great deal of nursing practice in ICU has its own localised dilemmas, which can throw up divergent ethical justifications. Either in extract example [Fn10, p.179] given above of keeping patients 'alive' on machines in order for loved ones to witness the dying of the patient, (a life passage that is held in many societies); or the ethically sanctioned view that organ donation will allow another individual a better chance of survival. In these micro interactions, the nurse is pulling together heterogeneous elements such as ventilators, monitors, cultural expectations around death and medical expertise. While the nurse engineers these heterogeneous elements, the interaction produces particular effects: firstly, the technology is co-opted to prolong life not directly for the patient's benefit. Secondly, nurses are presented as empathic agents, able to negotiate the boundary between the techno-medical sphere and psychosocial world of patients and their families. In the end, nurses are trying to manage local contexts of practice, and each context results in the shaping, or translation of particular elements (humans, technology etc.) to achieve outcomes, which are again meaningfully appropriate to the micro context of action.

In this chapter, I have attempted to draw a picture of how nurses use technology to achieve social goals. I have shown that nurses use their knowledge of the machines and patients to gain professional status alongside medical staff. I suggest that nurses' position in ICU actor networks allows the opportunity for them to act as heterogeneous engineers; where their activities of translation or shaping of technological elements affords symbolic power in their interaction with other professionals. Although all actions performed by nurses are directed to caring for patients, what the notion of caring might entail can take on many forms. It most definitely includes the specific use of technology to maintain biological function. This was highlighted in nurses' descriptions of the technological affordances of machines when looking after patient's biophysical needs during illness. However, the nurses' idea of caring covers a spectrum of tasks, not least nurses' professional belief that their role as care givers extends towards caring for patients as social beings within the network of familial alliances. If the idea of nurses as heterogeneous engineers can include 'death observance' and 'organ donation' as attempts to build or at least stabilise existing networks, I showed through nurses' accounts that the symbolic or semiotic handling of medical devices shaped the social affordances of the ICU technology, as a strategic element in network building and stability.

3.0 METHODOLOGY

3.1 Patient Representations through Technological Care

This section explores nurse-patient interaction and the symbolic relationality that goes on between these two actants. I suggest that the forms of action described as nursing activity and patient care delivery are the outcome of many other heterogeneous elements that play a part as resources for action in the ICU network. As a way to enter into this sphere of interaction, and to highlight the temporal element embedded in all nursing care, I will first lay out a heuristic model of what takes place when nurses are involved in the patient technology nexus. The model, which is derived from interview data and observations, encapsulates nurses' perceptions of patients when they are trying to negotiate care regimes through technological means. The model uses the terms 'compliant' and 'resistant' patient-body situated along one axis. On a parallel axis lies the idea of the 'technological' and 'social' patient.

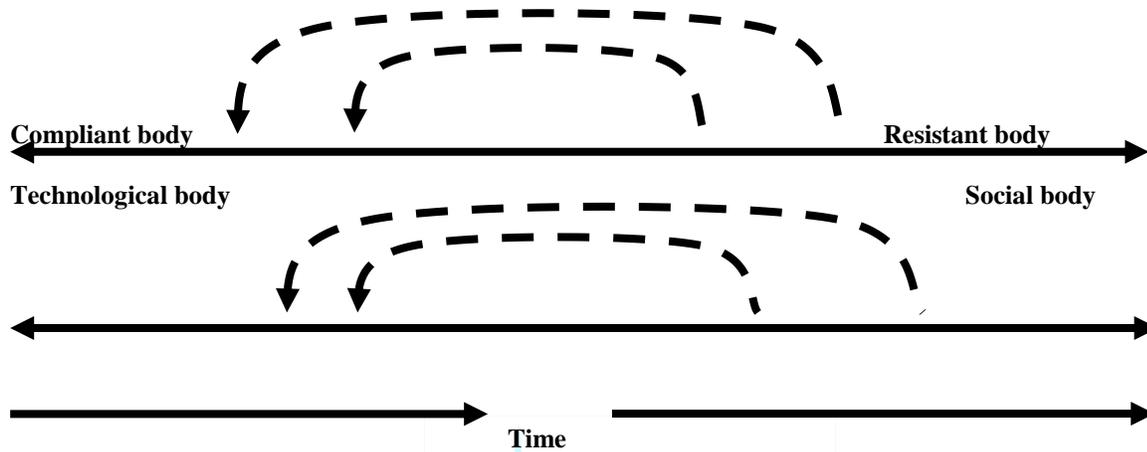


Figure 1: Model of nurses' representation of patients

Crucial to this representational model of nurses' views of ICU patients is that moving from left to right along both axes represents a spectrum of nurses' views on patients and a corresponding nursing care process. Furthermore, both lines of process are underscored by a temporal dimension. The move from a compliant to resistant patient-body happens over time, as does the movement from technological to social bodies. I use the term 'resistant body' not necessarily to depict a conscious decision on the part of patients to refuse treatment regimes, but rather the patient's body resists the technological flow by dint of its physiological and biological facticity. For example, blood coagulation as a fact of human biology will interfere with the effective application of dialysis. In this way the clogging of blood will cause a resistance in efforts to filtrate the patient. Compliance to the technology in this example will require feeding anti-coagulates through the blood/technology system while filtration occurs. Anti-coagulants are a further technology that ensures the translation of blood onto the filtration technology network. Similarly, as we will see, body movement from unconscious patients interferes with the site area where lines enter the body: kinks in input and output lines such as monitoring devices and syringe drivers disrupt the activity of technology. This again is a form of resistance. To enable the necessary invasive application of lines, patient's bodies are compelled to be compliant through other technological means such as the use of medically induced comas through bolus sedation.

In the model, time, as a linear phenomenon, moves hour to hour into days and possibly into weeks for many patients' on ICU. In ideal ICU nursing and medical interventions the passage of time would reflect care processes where the patient's condition would progressively improve, eventually reaching full recovery. However, nursing extremely sick and vulnerable patients is seldom like this in nurses' experience. In many cases, time and expert care may provide gradual steps in recovery, only to be met with a reversal in the improvement of the patient's condition. At these points, nursing and medical staff are forced to reassess the patient and attempt other care interventions involving other forms of health technology. Returning to the model above of nurses' representation of the patient, although time moves on there is the potential difficulty in recovery resulting in patients falling back into earlier states of illness. Correspondingly, nurses' views of patients may also return to prior forms of representation. So, although time is linear, the model, which is after all a heuristic of nurses' representation of patients in the ebb and flow of recovery, may see reversal; for example, the resistant patient-body returning to a state of compliance particularly, as we will see, when induced coma by sedation is necessary for ongoing care. This is a clear example of how technology plays a pivotal part in ICU care, where its use in coma inducement through bolus syringe drivers enables the unhindered application of other devices in the care of a compliant patient-body. Here, in the nexus of patient and

technology and nursing practice, forms of patient representation emerge. There are a number of conceptual matters which I have discussed so far that need clarity in order to understand where the network of elements impacts on the representations of patients and nurses. I will now discuss how the analytical model reflects the experiences of nurses immersed within the technological environment of the ICU.

3.2 Technology Compliant and Resistant Patient-Bodies

The correct 'reading' of monitors and subsequent setting up of organ support devices is viewed as paramount in the task of delivering effective ICU care. In these circumstances nurses desire the smooth running of medical devices. As a corollary, in this realm of technological activity, nurses require 'compliant patients' - a passive or compliant patient is a motionless passive actor. In order to function properly much of the invasive medical technology used in the ICU requires that sites where technology and bodies come together are stationary. Therefore, nurses prefer still bodies to care for, if only to ensure that the technology performs its role adequately. *Fn09, female nurse: "If you've got a sedated patient, brilliant because they're not going to move. But if you've got someone who's moving who's awake or...when you just turn the patient the machine does not like it. It will scream and shout at you...Because you need good access you normally use either the neck or your [the patient's] groin. If you've got a sedated patient, brilliant because they're not going to move, but if you've got someone who's moving who's awake the machine does not like it. It will scream and shout at you..."*

As the above indicates patients will at times move in bed, as a result of bodily injury, disease, other biophysical pathology, or the obvious distress of prolonged periods in the same position. At these times, contrary to the compliant patient, bodies become resistant to the technological interventions that nurses and medical staff attempt to instigate in efforts to provide care. One dramatic example of this need to ensure compliance from the patient, in the intervention of medical technology, is when the patient is on the ventilator machine. When this form of treatment is in operation the mechanics of ventilation are different to how humans breathe normally. In the following account, the nurse describes the semi-conscious patient's natural resistance to ventilation. The passage also highlights the fact that the obligatory need to apply ventilation for the betterment of the patient, requires that the patient be made to comply with the technological requirements of the machine. In this case the patient is pacified through sedation to allow the machine to operate effectively. *Mn03, male nurse: "The aim for us is not to have someone more heavily sedated than necessary to allow us to support their care. If the patient is in that half-way house- not fully conscious not fully sedate- they may not like the sensation of being ventilated. It's the exact opposite to the way we breathe normally. They're having air blown into their lungs and patients can react against that. The term is 'fighting the ventilator'. Now if by the patient holding their breath against the ventilator, they stop moving gas effectively. Because they are becoming too aware of the ventilator then I may need to sedate them more heavily to facilitate their ventilation."*

The nurse's use of the term 'fighting the ventilator' becomes representative of the patient as resistant to technologically invasive therapy. As such, patient resistance flies in the face of what nurses require from patients in carrying out their care practice with technology. By achieving the compliant patient through other associated technology the nurses are in effect ensuring the overall operation of the network. To be non-complaint with the technocare disrupts the network. It is an act of defiance that demonstrates all the qualities of 'anti-program' action (Akrich & Latour, 1992); therefore nurses (and medical specialists) have to go to work to achieve the translation of patients onto the technological network. In this instance the patient is sedated, drawn into an induced coma, a strategy that ICU care regularly uses in order to carry out the necessary medical and nursing interventions.

There is a sense that designers and manufactures construct medical technologies with an ideal representation of the patients who will interact with these devices. To some extent the 'patient' as component must, in order to reach design completion, be black-boxed as a compliant and conducive body which is receptive to technological intervention. However, black-boxes have the potential to be 'leaky' (Callon & Latour, 1981, p.286). In the case of filtration, involuntary movement, incorrect positioning of cannulas, blood coagulation and so forth, all act as 'reverse salients' (Hughes, 1993), anti-program challenges to be overcome in the management of technological networks. As one nurse put it, design of medical technology works with, "*the notion of a patient who doesn't move, yes that's the way they're designed*" [Fn07]. Nevertheless, the importance of technology to the function of ICU practice is not underestimated by nurses, without its ubiquitous presence, nurses shared the notion that intensive care would not exist: *Fn19, female nurse: "I think if we didn't have the technology we wouldn't have intensive care. We use all the machines. The majority of them; some of them are simpler. But the ventilator and kidney machines, you wouldn't be able to support people without them. It plays quite a big role in intensive care."* Nurses however are all too aware that this nexus of patient and technology can, at times, be the site of irritation. In the next extract the nurse talks of the specific issues that arise in the real-world experience of setting up technology. *Fn07, female nurse: "For a start the kidney machines are a nightmare at times. It is so time-consuming. Did you see a nurse run the machine through?"* *Researcher: "Yes."* *Fn07, female nurse: "Sometimes you can do that two or three times on the shift because it's not*

working properly. It keeps alarming because the cannula's position is wrong; the patient's moving or kicking their legs if it's here [points to cannula site]. So yes I could go mad sometimes on..." Above the nurse appears to put the technological fault partially at the patient's feet - no pun intended. This form of physical resistance from patient's bodies to the smooth working of the technology emerges in a number of nurses accounts. When the function of ICU nursing requires the harnessing of complex technology to ensure patient survival, many nurses view bodies as a factor which must be controlled in the management of technologically driven care. In the next extract, interestingly, the breakdown of monitoring is, according to the nurse, the fault of the patient. The monitor is perceived as neutral, only delivering information that is picked up from the resistant patient. The blocking of information is due to the patient's blood coagulating, the kinks on the line are due to patient movement.

Mn01, male nurse: It's not the monitor, it's the patient that's at fault. It's the patient end of the monitor generally. It is the interface between the patient and the technology that's the problem. So the line that goes through the patient's skin into their artery- that can get blocked, or it can get kinked and that's going to affect the reading. You know the monitor is just going to tell you the readings that it's picking up." In this ICU environment technology becomes one of the key players in the survival stakes. Anything that runs up against the correct function of the technology must inevitably be corrected to ensure that technological efforts directed at patient recovery are optimised. This technology, as I have said previously, works in a network of associations. Moreover, each actant drawn into the association of heterogeneous elements must go through some form of translation, some form of change which makes them suitable for network stability. I suggest here those patients' bodies by way of blood and muscle movement must also be aligned with the technological network which operates to produce effective kidney filtration of blood-gases stability. These medical interventions and the devices they require become obligatory points of passage if patients are to survive. Thus, the use of sedation for example operates as a translation device serving to ensure the compliance of hitherto resistant patient bodies. Nurses for their part play a major role in translating patients' bodies through those passage points in the network.

Fn05, female nurse: "And because you've got all this to deal with, making sure everything's tickety-boo and running along the patient's sedated, ventilated... I know it sounds awful- but you need to make sure everything's just going as it should do... all of this [the technology] to be working right in order for the patient to get better, that comes a bit first if you see what I mean."

3.3 Technological and Social Patient-Bodies

The patient is subsumed into the technology network in the same moment that their survival becomes the be all and end all of why the technology intense environment exists. For the patient to have any hope of recovery means something is temporarily lost in the fight; I mean by this patients, as 'social beings' are low in priority for nurses while they strive to make their life viable. As Carl May (1992) points out: *"As a body this patient is defined not by its idiosyncratic features, but by its relationship to a general set of technical knowledge and the professional or paraprofessional actors who deploy them"* (p.474). As a corollary to this techno-social set of affairs, patients as technology compliant actants are uppermost. In the model introduced earlier I mention the idea of 'technological bodies' positioned below 'compliant bodies' at the same moment in the time line. I have in mind here the notion that patients, or at least their bodies, have to become components of the network, they become cyborg-like in the technology nexus. This analytical point is brought to bear on the following two data extracts. In the first, the nurse mentions that the patient disappears subsumed in the flows and connections of the medical devices that surround and interact with their body. The representation in the nurse's account configures the 'patient' as contextually bound to the exacting function of the medical technology. Interestingly, the account also reveals a form of reflective dissonance: between what needs to be done for the patient and the ethical quandary of losing the patient's autonomy (at least as a social being) through the nurses' professional techno-practice. Words such as 'awful' and 'suffers' reflect that the nurse is aware how care under medical technological regimes might appear as a total objectification of the patient.

Fn05, female nurse: "And it's not that the patient suffers but sometimes you see them...I know it sounds awful but you see them as this patient that's attached to everything and you need to make sure everything's just going as it should do so yes you can understand how the patient disappears." The second extract below, adds further to nurse's problem of disassociating the patient from their self-hood. The separation that the nurse makes between human and individuals is interesting as it suggests that the 'individual' comes from being part of the social landscape; it is in this context that the patient mediates all the socio-cultural resources that furnish their individuality. To the point selfhood is a social network building strategy (Latour, 2005) and as the extract makes clear, language is one of the tools and resources of self-hood building. As the nurse succinctly indicates in the next quote if the patient is not able to talk to them it is hard to view them as individuals.

Fn10, female nurse "Because a lot of our patients don't talk to us, it's very easy to treat them like a piece...that's the wrong word. You still treat them as humans but you don't necessarily treat them as an individual."

Unfortunately the nurse cut herself off from finishing the utterance, “treat them like a piece...” but it might be assumed that the intention was to complete the utterance with the word ‘meat’. She could have said ‘piece of technology’, either way, she draws back from finishing the utterance with “...that’s the wrong word.” In truth she had not uttered the wrong word. But she let it hang in the air, obviously mindful that to complete the culturally understood adage ‘like a piece of meat’ would be to objectify the patient. As the previous extract makes clear, nurses in their accounts come across as vexed when confronted with the coma induced and technologically assigned patient. The situation rightly throws up ethical issues for nurses in terms of their care practice, in an environment that seems to remove individuality through the exigencies of the technological care that exist to keep patients alive. However, network building strategies around technological actants in the context of ICU is just one possible series of heterogeneous associations that go towards configuring the patient. For the time being however, while clinical care is focused on stabilising the patient’s organ function, there is no need per se to engage with other network associations that configure the patient as a ‘social’ agent that will come later. Meanwhile, the nurse in the quote below makes the same point succinctly.

Mn03, male nurse: “I want my patient to be happy, I want them to feel cared for and safe. But if I can’t keep their heart going long enough for me to develop that relationship. In the first instance I have to keep them alive to talk to me.” I shall describe at a later point in this chapter other efforts to build network associations that configure the patient as social actor. Future association will become important during the recovery period when the patient is removed from the brink, and indeed gradually from the technology. In the meantime, patient sedation for the purpose of technological care compels nurses to believe, as the next two accounts describe, that they never meet the patient as a ‘person’ while they remain under this techno-care regime.

Fn13, female nurse: “I think people do feel a bit like that, but I think again it’s easy in ICU because a lot of the time our patients are sedated. So we never meet them as people we only meet them as this person in a bed, and we meet the family, but we don’t meet the person. It can sometimes make it difficult to see them as the person they are.” And on a similar theme. *Fn05, female nurse: “Because you don’t actually know the person. If you meet their family you get something of a sense. But you don’t actually know the person until they are awake; what they are about; what they are like. Whereas physiologically you probably know a lot about them.”* Interestingly, in the latter account the nurse appears to understand the patient in terms of classical mind-body dualism. Here two forms of patient representation arise. Firstly, under the medical technological regime the patient as a body is interpreted through the assembly of physiological indicators aligned to the measuring and balancing outputs and inputs through technologically derived care interventions. As time moves on and the initial intensive care has been successful nurses look to understand the patient as a social being. This work of assembling the social patient of course starts as soon as possible. The two extracts above mention in passing the family as a conduit to discovering the personality of the unconscious patient. In the next quote the nurse indicates the importance of fleshing out, as it were, the social dimensions of the patient’s world. *Fn10, female nurse: “But a lot of the patients are obviously sedated, ventilated so you don’t actually get to know your patient unless you get to know your family...And you’re trying to pull some information out of them about the patient: ‘He liked going down the pub then does he?’ ‘Have a few drinks did he?’ Just to get the personality of the patient, and it’s not just the patient because their family’s important to them as well, so therefore for their wellbeing their family needs to be kept well.”*

In the quote above there is a perceptible movement from nursing care as a set of technological tasks involving compliant, technologically conveyed patients. Now as the patient is reconfigured as a social being through the building of associations with a wider family network, that same family network is recognised as holding importance to the patient. Therefore, in the nurse’s account, what becomes paramount is ensuring the wellbeing of the patient’s social networks by way of attending to the wellbeing of the patient’s kin. Earlier I emphasised that while the patient is in the acute stage of critical techno-care network building appears to be all about configuring the patient towards compliance to technology. As an obligatory passage point only the medical devices can keep the patient alive and stable. It also requires as a point of passage that the patient is translated and configured as an actant compliant to the requirements of the machines and their operators. I also stated that network alliances that held the patient together as a social agent would have to wait. Now, during recovery, the nurse is obliged to build those alliances that ensure the reconfiguration of the patient to their social existence (May, 1992a) . This could be viewed as the re-appropriation of patient’s ‘subjectivity’, furnished in the network of personal and social associations, which had hitherto been subsumed in the ‘objectifying’ activities of the techno-medical network.

3.4 Techno Bodies to Social Patients and Nurses’ Network Building

I have attempted thus far to demonstrate the analytical model of patient representation. In this I have demonstrated that in the initial period of ICU nursing intervention nurses require passive patients that are in effect made to comply with the technical specifications of the machines. In particular, it appears that ICU technology functions best when the patient is stationary. While patients are unconscious they merge with the technological

environment, as one nurse suggested they ‘disappear’ into the technological network. However, as the medical intervention develops, and signs of recovery become evident, there is a shift in the representation of the patient in nurses’ accounts. Now as the patient is lifted from sedation they take on a more social persona, as the next two accounts indicate: *Fn05, female nurse: “My last three shifts I’ve been looking after patients that have come off the ventilator and they’re heading for the ward. So you do get a better rapport with the patient because you’re able to chat to them for 12 hours and you get to know them, they get to know you and it is nice to have that.”* And from another nurse: *Mn09, male nurse: “When you do the morning wash or afternoon wash it’s quite a nice time to spend that time with the patient and talk to them. Have a chat with them, find out a bit about them maybe, get a really grip of who they are...”* In the accounts above there is a real sense that nurses see patients as transformed. Only now, after spending some days or possibly weeks caring for them, do the nurses feel that they can ‘get a grip’ of the patient as an individual. The patient’s ability to converse and interact in social encounters transforms them from technological related objects into social subjects.

A further signpost on the road to recovery, and transformation from the techno to the social world is evident in the notion that a woken patient requires less ‘interpretation’. Of course the notion of interpretation here is directed to the nurse’s technological observations of the patient while they were sedated and device compliant. At that juncture interpreting the patient meant the nurse understanding the patients as a series of organs in balance; as a constant stream of information from monitors, blood-gas analysers, ventilators and the rest? To the point, a series of operational steps consisting of inputs and outputs all performed, by necessity, through the hermeneutic gaze of the ICU technology. Now, as the quote indicates, that regime of understanding the patient as an illness condition has subsided, the task now is to understand the patient not as a techno-mediated patient, but as a social individual. *Fn12, female nurse: “Today I’ve had someone who is fully awake, but then with that I haven’t had a lot of things to interpret because they haven’t been needed as much. So I do think that the sicker the person is, and they are unconscious then you can’t talk to them, then you are focusing on the results. And the patients who are awake often need less interpretation.”* It should be pointed out that although the nurse in the extract above understands the situation as having moved from ‘interpreting’ the patient to some new state of relationality, this of course belies the hermeneutic fact that any new state of affairs also relies on forms of interpretation from the nurse towards the ‘patient’, and indeed vice versa. Nevertheless, it is of interest to note that the nurse, in her view, sees the patient, now unencumbered with technology, as a qualitatively different form of actant.

Further to the nurse’s interpretive aims while patients are under the medico-technological interventions, when the patient eventually reaches a stage of recovery the same life saving devices becomes a hindrance to the ongoing nursing care. As I show in the next interview extract there is a point when the patient becomes resistant to the technology. At this point, it is not the patient who has to be made compliant to the technical requirements of medical devices, but instead it is the technology that takes on a position of redundancy. *Mn01, male nurse: “When patients are quite awake and alert and you can see that. We often take some of the monitoring off, because it bothers them more than anything. And you can see clinically they are okay. We tend to take ECG off and stuff like that.”* If this idea of a gradual shift from the intensive scrutiny of the body, through technological interventions, to consideration of social patient with mental faculties needed clarity, it was evident in the following data extract. As the quote reveals, only at the point when the patient emerged from sedation, could care turn to addressing their psychosocial wellbeing. *Mn03, male nurse: “It’s only when someone is free of that sedation ...can I start to work on their psychology, their mental function.”* Of course, technology still has a part to play, but as the patient recovers other associations become important concerning future matters of rehabilitation. As the nurse in the following statement makes clear there is a need to look beyond saving a patient’s life as a success for medical technology intervention. This may be true in the context of ICU, but outside the confines of the ICU, quality of life means more than survival from critical illness.

Mn17, male nurse: “A neurosurgeon might come along and says that there’s no way of recovering from this, but because he is a young man we are going to go along and do an operation and see how it goes. There comes a point where you have to accept that with all the technology you have got are not going to make life better for anybody, and there does come that point and determining when that point is very important. Because you can potentially destroy not only the quality of life for the patient, but also the quality of life for the people who have to care for the patient.”

As the nurse’s account indicates, less than full recovery is likely to result in a reduction in the ‘quality of life’ not only for the patient but also for family associated with the patient. The argument for and against the continuation of care under technological regimes remains a constant debate in the world of nursing, particularly in palliative and end of life care (Carlet et al., 2004; Blackhall et al., 1999). However, what is interesting in the account above is that the nurse, in considering the long-view of the patient’s situation, draws attention to how networks operate and how the ICU nurse might work across network boundaries.

In this case, the ICU network demarcated in the quote demonstrates the ascendancy of neuro-surgical and technological expertise on how the patient should be treated; that is to say, cure by any means. Through the neuro-

surgical network, constituted by surgeons, anaesthetists, nurses and technology intensive operating theatres (among other actants), it might be possible to build an argument for operating on the patient. However, as the comment above indicates, the nurse demonstrates some resistance to translation onto the surgical pathway. Instead, they look towards the patient's quality of life as a component of other existing and future social networks outside of the ICU world-view. In effect, as boundary object, the nurse is working strategically to shift opinion on the intended surgical intervention. One strategy is to convince other actants that the nurse speaks on behalf of the patient as their appointed advocates. The next extract follows on from the same nurse's [Mn17] comment above. In the same theme as the previous quote, the interviewee talks about surgical intervention but questions the purpose of this when outcomes might be unsatisfactory in relation to the patient's future capacity to have a meaningful social existence. *Mn17, male nurse: "we are very vocal about this [further intervention], and we pride ourselves on being advocates for people when they cannot speak up for themselves."* A further strategy, as the next extract from the same conversation with Mn17 indicates, involves the nurse insisting that relatives remain at the bedside to witness the invasiveness of ICU interventions at the cost of patient dignity, even when little is expected of a positive outcome. *Mn17, male nurse: "The family have to be here while we continue to do something with no quality outcome possible."*

In each case, be it calls for patient advocacy in light of surgical intervention or convincing families, the nurse is pulling together heterogeneous elements, attempting to pass them across boundaries into different network alliances. As the nurse suggests, quality of life is more than just being alive. It requires the network building of rehabilitation services and familial associations, assistive technologies and so on, in order for the patient to have a quality of social existence, comparable to their life before illness. Getting patients back "to how they were", as the next quote suggests, requires the effort of heterogeneous elements and new alliances across networks to continue the patient's 'story' *Mn17, male nurse: "If we lose sight of what happens after here, it is not in any way the end of the story and really getting someone back to how they were is the aim always."* More than any other professionals on the ICU, nurses encounter the extended networks of family and allied professions that will influence the after-care of the patient. It will be nurses, as part of their duty of care, who will handle the patient's transition out of the ICU. Thus, nurses have to manage this boundary between ICU and other wards and hospital departments dealing with the patient's long-term rehabilitation. Stepping between the ICU network which inscribes the technological patient-body, and the network associations of the 'rehabilitation network' which inscribes the social patient-body, the nurses act as a boundary object to bring an understanding of both groups to bear on each other. Nurses who mentioned this dilemma in care practice were also vociferous in ensuring that the ethical standards of care of the ICU were not totally driven by the intervening capacities of ICU technology. For ICU nurses, keeping people alive, by whatever means requires the recognition that patients as social beings differ from technological bodies; and that they need resources by way of network support beyond the ICU in order to remain the status as immutable social beings.

3.5 ICU Nursing Vigils: Care, Technology and Patients

In the previous sections I have indicated that nurses construct representations of patients. In summary, these inscriptions of patients, as compliant and resistant, align with the exigencies of the medical technology used by nurses to affect some form of recovery and 'cure'. Through the stages of care management of patients from critical illness to recovery (and unfortunately in some circumstances death) a further transition of the embodied patient occurs. Firstly, compliant bodies are technological bodies, appropriated as part of the technological network. Secondly, as recovery takes place patients who were previously subsumed in the flow of technological inputs and outputs, emerge in recovery to be configured as social patient-bodies. This transition, if it happens, is never a straightforward march towards recovery. At times compliance may turn to technology resistance, where the need might be to return the patient back to a state of technological compliance, through the administering of sedation. I want to conclude this section by exploring the notion that the interactions between nurses, technology and patients present two forms of vigil: the *care vigil* and the *technology vigil*. As the concepts suggest, the care vigil is directed towards the patient, whereas the technological vigil draws attention to the necessity of nurses to be vigilant towards the technology. In the ICU both vigils, and the attention received by nurses towards them, results in an overlap. As the interview extracts reveal, at times, attending to both vigils can become a point of tension.

3.6 ICU Nursing and the Care Vigil

For those nurses interviewed, the *care vigil* represents nursing practice directed primarily towards the patient (although arguably all care is directed towards the patient) and it is usually associated with the idealised *Nightingale* approach to care. Direct patient care is witnessed in the idea of 'touch' as a fundamental aspect of nursing practice (Estabrooks, 1989). One aspect of touch that ICU nurses viewed as important in their practice was the delivery of basic care: washing the patient, providing oral hygiene, shaving, wound dressing and so on. Although the notion of the care vigil performed through direct contact with the patient can take many forms appropriate to nursing practices,

such as touch as an offering of comfort (Schoenhofer, 1989); or as a technique for gathering information on, for example, body temperature, and pain sensation in the patient. The fundamental point of the care vigil is the focus and attention which is paid to the patient. This idea might seem obvious, given the generally held view that ‘hands on’ care is the *raison d’être* for nursing. However, the technological complexity of ICU throws the commonly held view of nursing into question. For the nurses in the study technology plays a part in direct nursing care and it can take on certain procedures allowing nurses to attend to patients: *Mn01, male nurse*: “*The machines should free up more time for patient care not detract from it. Because writing observations down isn't patient care is it? Whereas cleaning their mouth or something is, and if you've got time freed up to do that more often then potentially your patient care is going to be better.*” The nurse in the previous comment makes the distinction between what nursing care is and is not. In their view, taking observations by way of monitoring technology is not patient care, whereas basic care (personal hygiene etc.) is seen appropriate to a model of nursing care. A number of nurses interviewed shared the idea that handling technology was not nursing practice. What nurses wanted from their care environment was for the devices to merge into the background allowing them to nurse in ways that were responsive to the needs of the patient. The suggestion that technology works best when it vanishes from direct care indicates attempts by nurses to bracket out their perceptions of the technology.

To grasp this understanding of how nurses go on in the world of the ICU is to indicate that they negotiate their involvement of technology as part of their embodied experience, which unfolds in the ICU environment. To express it in Heideggerian phenomenology is to insinuate that medical technology and the sphere of life it operates in is taken on by nurses as, “ready-at-hand” (Heidegger, 1962, quoted in Walters, 1995, p.341). The following interview extract, although in the nurse’s own words, exposes a particular understanding of readiness-at-hand: *Fn06, female nurse*: “*I actually think in some sense that the technology is blanked out. You don't think about that it's technology that you're using if I'm going to be honest you think about...I think you're so used to using it...* Developing her thoughts on the application of technology to her everyday practice, the nurse carries on her account by revealing present-at-hand quality of technology. Whereas the concept of ready-at-hand suggests a consummation of technology and unconscious embodied practice, when the technology breaks down the materiality of the device rushes back on the scene, becoming once more present-at-hand to the nurses consciousness. *Fn06, female nurse*: “*that's the problem that you just forget it's technology and you forget what you're relying on in a sense until it breaks down and stops working.*” In optimal circumstances, understanding is not about conscious awareness of the materiality of environment (and the technology within), or as Heidegger suggests ‘theorising’ about whatever is present, but an embodied practical unconsciousness that acts in and through the materiality of the technology and its usefulness (Walters, 1995).

It is constantly there, but somehow nurses have enveloped its materiality into their ongoing practice. The next quote reveals, some of the enframing work that nurses do to encompass the technological materiality of the ICU. The talk is about knowing, confidence, and experience. That is to say, experience with handling devices, knowing how it operates, and through that knowledge having confidence that the technology will perform. This all enables the nurses to focus their nursing practice on the patient and the care vigil. *Mn01, male nurse*: “*When you know how the ventilator works. When you know how the monitor works. When you get confident with the bits of kit, then you focus on those bits of kit recedes, and then you look at the patient.*” The receding that the nurse refers to is not the removal of the technology, away from the immediate space around the patient bay. The technology remains in proximity to the bed whereas consciousness of it diminishes. Unlike those nurses who viewed the technology as separate from the true practice of nursing, other nurses recognised the extent that technology played in affording them to carry on practicing as ICU nurses.

Fn13, female nurse: “*Making sure that the equipment is working properly directly affects how well you can care for your patients. I suppose for us the most important thing is that we are initially keeping these patients as stable as we can keep them; for us to be able to do that, we have to have accurate monitoring, and for all the machines to be working properly.*” In the quote above, the nurse recognises that the care practices of ICU could not go ahead without the input of technological systems. Fundamentally, the care vigil with its emphasis on direct contact with the patient would be unachievable without the ‘life saving’ properties of the medical devices. Nevertheless, the accounting practices of nurses work to place technology on the periphery of what counts as nursing care. Drawing instead on those ‘care’ elements of their practice which summon up touch, concern and kindness as nursing qualities, nurses attempt to bolster the ideology of humanist nursing care (Rnic et al., 2008). As May et al. (2001) point out: “*In nursing, ‘being with’ the patient has come to have an ideological significance that is oriented towards ‘holistic’ care, and the notion that nurse–patient interaction is intrinsically therapeutic.*” (p.1891). What can be said about this in terms of network strategies? As Latour and Woolgar (1986) point out, science only becomes ‘science’ when the ladder of social symmetry is kicked away. On the same lines it might be said of interviewees presenting accounts foregrounding the humanism of nursing, with the focus on the care vigil, only happens when the support of medical science and technology are eliminated or ‘kicked away’. With the next quote, the nurse’s account emphasises the

ideology of nursing and the care vigil, while at the same time reducing the importance of the technological infrastructure that makes care possible.

Mn03, male nurse: "The numbers aren't the patient. It is not a kidney issue it's a patient dying issue. It isn't an interest in balancing between two numbers, because they're going to die. And I'm going to have to explain to a family why 'Jim' their dad or brother or husband isn't here anymore." It is not about the technology and what it offers to patient survival; it is not about abstracting the patient to the level of balancing numbers. The discursive strategy of the nurse in the quote above operates to emphasise the centrality of humanism in nursing, and the vigil of care focused on the patient as a human being who matters to others.

3.7 Technological Vigil, the Return of the Devices

If the care vigil outlined above has its focus on the primacy of direct nursing care, then the emphasis of technological vigil rest upon nurses' attendance to the machines. As I have said throughout this thesis, very little could be achieved in terms of intensive care nursing without the technology. Although, in the scheme of ICU care practice, nurses would prefer the medical devices they use to meld into the background (ready-at-hand) allowing them to attend to direct patient care. However, the technology will eventually make its presence known drawing the nurse into problem solving situations, which must be resolved in order for the care vigil to proceed. To ensure that machines carry on the crucial role of supporting vital organ systems constant maintenance or troubleshooting is part of the ordering of the ICU. Although the care vigil reflects an ideological dedication to the pursuit of hands-on holistic care, what also counts as nursing in the ICU has a great deal to do with the maintenance of machines. To the extent that nurses' accounts attest to the amount of time and attention they pay to the devices, as the next quote indicates:

Fn09, female nurse: "The kidney machines, we rely on them for renal failure. They can be a pain though. If they don't want to play ball you just want to pick them up and throw them out of the window. Especially I find if the line is sited in the groin the filter will not run effectively. It will constantly alarm and you spend a lot of time pressing buttons, altering flows to try to get it to run. That's the biggest pain." Of all the technology nurses reported difficulties with, high on the agenda were the blood filtration machines. These machines among all other devices presented nurses with the constant requirements to troubleshoot problems. Indeed the skill of troubleshooting devices appeared to be equated as a fundamental care component alongside personal care in the ICU. *Fn06, female nurse: "I think the troubleshooting is a massive part of ICU nursing. Knowing what you're doing with the equipment because it takes a long time to conquer all the troubleshooting on a machine before you feel confident to then use it."* The apparent constant need to troubleshoot problems with the filtration machines is perhaps due to the level of invasiveness of the machine in relation to the patient. The fact that the technique of filtration means the patient's blood leaves their system and enters into the technology system of the filtration machine, directs nurses to the crucial functioning of the machines; heightening their technological vigil over the machine as it undergoes the filtration cycle. In the following quote the nurse talks about the technology vigil as a 'looking after', a turn of phrase perhaps usually associated with the care of patients.

Mn20, male nurse: "Yeah, sometimes you're not to look after the patient. For example today, there's a nurse looking after one of the CVVH [filtration] machines the renal machines. And that's been playing up all day that that's taking up the majority of her time looking after that machine. And how much input has been given to that patient? Very little, so, she's looked after that machine." Similarly from another nurse, they talk about the time and attention needed to operate the filtration machine. In their turn to the technological vigil they are absorbed by the machine, to the extent that the needs of the patient and the care vigil become a distraction. *Mn01, male nurse: "Certainly when you get problems with machines the kidney machines can be quite temperamental and you can spend some time a lot of time, and you do get absorbed in the bit of kit, rather than the patient. And the patient can sort of interrupt you while you're sorting that bit of machinery."* 'Looking after' machines, as the quote from Fn20 indicates, have an inevitable effect on the nurse's perception of the patient. The patient vanishes from the immediate context of care as the nurse concentrates attention towards the machine vigil. Disconcerting as it seems to the nurse, the focus of care work is upon the functioning of the machine; somehow the patient as a technological body is subsumed in the filtration system. Therefore, for the nurse in the next extract, to look after the machine has in this moment the same quality as looking after the patient.

Fn14, female nurse: "You have to look after the technology...The technology as I was saying before, it's life-saving, so you have to look after the technology to look after the patient in a way; because without that, the patient probably wouldn't be alive." In accounts given by nurses, carrying out the invasive therapy of filtration procedures holds some trepidation. Removing the patient's blood from their body, to circulate around the filtration machine, holds the connotation that the life source of the patient is contained in the technological systems of pumps and filters. Therefore, it stands to reason that for nurses this procedure marks a liminal passage point where it might be considered: where does the technological system start and the patient's renal system end? Of course, that the patient, through their

blood removal, extends beyond the body into the machine, all attention is paid to proper functioning of the technology, constituted in the technological vigil. *Fn12, female nurse: "I think it's because it's such an invasive piece of equipment, in that what it does to the patient, it withdraws blood, filters it and then puts it back, and I guess there are quite a few things that can go wrong with it."* Yet all interviewees, at some point in their accounts, expressed a love-hate relationship with the medical technology they use. Some talked about wanting to 'kick it out the window'. Another nurse mentioned, "you have to make that machine your friend"; a few talked about technology as "temperamental". All these points suggest certain anthropomorphic tendencies towards the machine. ANT has no problem with this, as a theory of the social it acknowledges the power of artefacts to effect social arrangements (Latour, 2000). They are a vital component of network alliances. Why would a nurse say that she had to make friends with the technology; if not to align or translate her interests with that of the machine? The machine does what she cannot; therefore, she has to seek out these alliances in order for her to fulfil her role as a nurse. What happens when the technology has outlived its usefulness - what then? We are told by ANT that all actants, human and non-human, adhere to networks only for as long as it serves their interests. If these interests can be satisfied in other alliances, the exodus of actants is likely to undermine the original network (Law, 1992). So it is with nurses and the introduction of new devices, if innovation happens to enrol the interests of nurse actants, then the network maintaining efforts of old technology come under threat of collapse. In one interview, this mixture of network breakdown and machine anthropomorphism was poignantly described when one nurse suggested that the older filtration machines were dying:

Fn02, female nurse: "Yes the Aquarius [filtration machine] has been a bit temperamental; especially over the last few months I think they're dying really (laughs)." Researcher: "It's fascinating you use the word dying for a piece of technology. Do you know what I mean? Fn02: "I think so yes. I mean I wasn't working with them but I know just before Christmas and the last few months they've been setting them up and putting them on patients and they've not been working perhaps as well as what they should have been and I think they're just on their way out really. I think they've just been used too much." Analytically, how do the care and technology vigils fit in with nurses' representations of patient discussed at the beginning of the chapter? It could be considered that in the first stages of care, where the patient's condition required intensive technological input, the patient as technological body adheres to nurses' practice focused on the technological vigil. As the patient hopefully recovers the social patient returns and the care vigil takes over.

However, I feel this is too linear in explanation. Of course, patients will require the direct care throughout their time in the ICU, making the care vigil vital to all aspects of ICU nursing. Nevertheless, it is true to suggest that in dealing with the sickest of patients on the ICU, nurses also find it necessary to divert their attention to the technology, to ensure the patients survival. On occasion when the focus is on the machines, nurses seem to berate themselves for neglecting the patients and on the time spent in setting up and troubleshooting the technology. However, others recognise that the ICU nursing necessarily involves the task of troubleshooting problems that arise with the technology, and view it as a vital component of their care of patients. In the end, the picture is not linear at all, but one that captures the ebb and flow of nurse practice; the shifting emphasis from one set of performative actions to another from the patient to the technology. One moment the nurses focus is on the patient- washing them, positioning, combing hair. The next they are embroiled in the functionality of pumps, filter, tubes, and wires. At any given moment in nurses' care routines their practices around patients and technology offer the potential for the construction of forms of nursing identity (Lehoux et al., 2008). Nevertheless, it seems, all practice, is connected with the important aim of improving patients with the chances of recovery.

4.0 RESULT EVALUATION

In the review of the literature, I presented some theories of technological understanding. I wrote about determinism as an explanation of technology, but concluded that determinism presented too reductive an approach to the place of technology in society. By contrast, a social shaping perspective on technology considered that devices, machines and indeed innovations come about, and are shaped through social actors either working in consort, as in relative interest groups sharing the same concerns regarding the development of particular technological objects, or groups and individuals in conflict over certain technological developments (Akrich, 1992). The constructionist or social shaping model of technological development insists that new technology has to be understood within the wider context of social, economic, and moral worlds. This particular cluster of theories insists that no technology arrives on the scene as some finished object ready to influence social interaction. Instead, technology is shifted, shaped, and made compliant to the social context of its application.

I presented the findings in four chapters. In each chapter, I wanted to cluster the findings around themes that developed from the analysis. Chapter 5 explored dependency and suggested that nurses' actions were to some extent determined by the technology. Chapter 6 explored how nurses might shape the technology for social purposes beyond

the given designed use of the technology. In chapter 7 I presented evidence that indicated how nurses, in mediation with technology, formed representations of patients.

While this structure might have suggested recourse to the determinist/essentialist dichotomy outlined by Timmermans and Berg (2003), my purpose in using this vocabulary was to explore how ANT may explain particular nursing interactions around technology which exhibit qualities of both determinism and social constructivism. ANT would not deny that actants could be at one moment determined by technology; however, this is not absolute. At one moment, nurses appeared to be calling the shots, building heterogeneous elements together to promote a particular outcome. A moment later, technology as an obligatory point of passage (Callon, 1986b) required nurses to perform and interact at the behest of the machine. Here, it might be said that the machine is the heterogeneous engineer, consolidating disparate objects such as patients, blood tests, and nursing protocols. The thrust of my argument was that networks produce effects that seem to reflect classic modalities of talking about technology.

Similarly, when ANT talks about 'intermediaries' and 'mediators' (Latour, 2005, p.37-46), there is both a discernable deterministic and shaping quality, respectively, placed upon actants' action. Whereas *mediators* shape the configuration of the network and the objects therein; *intermediaries*, in Latour's words, "...are *made* to act by many other" (2005, p.46, Latour's italics), therefore, having a determined quality to them. The difficulty is in knowing what the actant's role is in the network at any given moment. ANT revealed the dynamic nature of nurses' understanding and interaction with technology in the empirical world of the ICU, though when dealing with the world through the lens of ANT; when ANT recommends that the researcher 'follow the actors', one has to be prepared to shift sociological certainties (Latour, 1987, 2005). Invariably, nurses' accounts (as with all actors) present a discursive tangle of actions of reciprocity, values, empowerment, and submissions and so on. In the discussion that follows, I will demonstrate how ANT has explained how nurses interact with the technology within the context of the ICU.

4.1 Nurses as dependent actants in networks

In chapter 5 I explored how nurses, as an effect of the network configuration, come to be dependent on the technology they work with in their care practices. The reason for this lies with the critical nature of the illness presented to ICU staff. Illness, injury, and disease that require medical interventions at the micro physiological level also rely on the input of sophisticated technology that can observe and report on the progress of illness. Because nurses become dependent on the technology to perform effective treatment regimes, nurses enter into network arrangements where the devices present as obligatory points of passage (Callon, 1986b). It is not that nurses are enrolled into networks unwillingly, as I highlighted in the findings, there is something to be gained for nurses in terms of role status by taking on the complex tasks surrounding technologically imbued care. To achieve this, nurses become locked into the network where the task in hand is to 'look after organs', 'chase numbers' or 'balance patients'. As I indicated when reporting the findings, these metaphors for nursing care are constituted by the functionality of the technology. The necessary dependency on the technology for nurses to provide critical care involves framing the patient's illness in line with the operational purpose of the technology. Where separate devices are designed to maintain each organ system (ventilators for lungs, dialysis machines for blood etc.), nurses' understanding of the patient's illness and the care processes involved is directed towards 'looking after organs'.

This thesis has demonstrated that ICU nurses have to work within the medical technology network if they are to care for patients. Moreover, whatever technology the patient's condition calls for, the device operates as an obligatory passage point. It claims the attention of the nurses, and shapes the conditions of interaction, even to the point where the patient is enrolled and configured in line with the technological discourse. Thus, nurses talked about chasing and balancing numbers as a stand-in for patient stability. Numbers are important in the ICU technology network; they are forms of text or inscriptions. Inscriptions work as rhetorical devices, carrying within them, in the context of the ICU, persuasive power to alter and direct care interventions. Their purpose is to carry the modalities of medical science and technology to other locations to act as social objects of persuasion. Thus, the results from a routine blood-gases analysis entered onto a paper chart not only engages nurses' interests in continued involvement in the network aim- i.e. patient recovery, but also supplies evidence to maintain the *interesement* of other specialists in the ICU environment. Interestingly, in this example of activity surrounding the blood analysis technology, the nurse maintains their enrolment in the network through their dependency on the results to initiate further treatment (which might include the operation of the dialysis machine). It is in her/his interest to comply with the results and carry out subsequent treatment decisions. I suggest this is not only for the patient's sake, but also for the nurse to demonstrate that 'being a competent ICU nurse' requires performative interaction with an array of technological devices. The latter point directs attention to the fact that what an ICU nurse is- an issue of ontology- depends on nodes of action that bring together heterogeneous elements. John Law (1992) puts the argument for human and non-human constituency this way: "*Analytically, what counts as a person is an effect generated by a network of heterogeneous, interacting, materials. This is much the same argument as the one that I have already made about both scientific knowledge and*

the social world as a whole. But converted into a claim about humans it says that people are who they are because they are a patterned network of heterogeneous materials.” (p.383)

I would further add that ICU nurses’ understanding of their professional status and nursing identity is intrinsically linked to their network activities around technology. It is also pivotal to who they are as ‘individuals’. This is to say, they have a psycho-social interest in maintaining ‘subjectivity’. I feel this is the same point made by May and Fleming (1997) in that they raise the valid assertion that the content of nurses’ empirical practice assigns their identity. However, I would further agree with Miettinen (1999), who insists that the “world of artefacts is a precondition for human subjectivity” (p.190). This point is just as true for the subjective experience of nursing identity in the technological environment of the ICU. It might appear that when talking about nurses’ dependency on technology, the machines have ascendancy, enrolling nurses towards specific channels of interaction framed by the exigencies of the medical devices. In the example of blood-gases analysis, the outputs inscription from the machine directs nurses’ actions towards further technological involvement in the network. However, demonstrating the dynamism in network configurations, nurses may also operate as heterogeneous engineers, using these inscription devices to enrol further actants, including other medical devices and professionals, onto the network. In their efforts to secure recovery for patients, nurses deploy blood analysis results as text evidence to translate the interests and concerns of medical specialists- and their technologies- to get involved in the patient’s case. The point I am trying to make here is that ANT helps untangle the network pathways; letting the researcher explore contingent alliances and the types of objects/subjects they produce e.g. the dependent nurse, the determining machine. By tracing the actions and intentions of actants, human and non-human, analysis can ascertain the flow of influence at specific moments in the network, and the contingent worlds they make.

On the contrary, if analysis remains chained to forms of technological determinism, the structural propensity towards determinist explanations would necessarily dismiss the analytical potential of viewing nurses, even within technologically pervasive circumstances, as network builders and shapers of socio-technical interaction. ANT leaves the unfolding scene of actant interaction open to indeterminacy and change, moment by moment. According to Singleton and Michael (1993), the indeterminacy and ambivalence of elements within networks should not be looked upon as an issue of analytical fuzzy-ness. On the contrary, indeterminacy is about actants taking up or being allocated roles within the network, which are at one moment intrinsic to the configuration of the network, and at the next marginal to the centre of action. Nurses’ role in network associations is encapsulated in the ideas of centrality and marginality. Take the next two quotes from the findings as examples. In the first, the nurse’s account describes their dependency on the technology as a way to understand the patient’s condition. The nurse waits for information to determine her actions towards caring for the patient. At this node in the technology-patient-nurse network, the monitoring device effectively determines the input of other actants - namely nurses. The nurse, for her part, remains marginal to the technology-patient interaction, only responding, as her account indicates, when the technology delivers information on the course of care. *Fn01, female nurse: “What information you’ve got from it [monitor] will determine how you’re going to look actually, not from a clinical medical point of view but from a nursing point of view, how you are going to care for that patient.”*

In the extract, the nurse appears to position herself in a line of command where she perceived her nursing role as being able to respond adequately to the signs from the medical technology. This role position could be taken as identity-in-practice work, where the individual sees ICU nursing as the ability to respond to the technology. On the other hand, it could be viewed as the technology translating the nurse, ensuring that the nurse understands her requirements as an effective ICU nurse, able to handle and respond to the monitoring outputs. There is a feeling of ambivalence in this arrangement, where technological dependency also offers nurses a form of identity management, *“from a nursing point of view”*. Fundamentally, ANT allows the researcher to think in these terms, that technological objects have agency to shape the understanding that nurses bring to their identity. If the marginality of nurses suggests a position outside the core action of network associations, then the notion of centrality puts the nurse-actant at the centre of network building strategies. The second quote below illustrates how nurses were able to take control of the construction of alliances, which were shaped by them to achieve the best possible care for their patients. *Fn09 female nurse: “I think we are quite autonomous in our practice for that one patient for a 12-hour shift or a seven-hour shift or whatever we are working. And we can initiate therapies, obviously working with the doctors; they are very receptive to our ideas. If we think something needs doing, they’ll agree ‘let’s go ahead with it’. We’re advocates of the patient as well.”*

In this quote, ICU nursing was now at the centre of action. The language use was authoritative, and indicates the kind of network building that had been accomplished in order for the nurse to practice with autonomy. For example, the statement that doctors *“are very receptive to our ideas”* suggested that the nurse assumes a stabilised set of responses from the doctor. If doctors are also the effect of network stability, then the nurse not only relies on the stabilisation on the doctor-network, but also works to maintain it. This might be through, as the nurse indicates, further

network strategies such as black boxing 'patient advocacy' as a role particular to nurses. The authoritative assertion inherent in the discourse around patient advocacy is enough to stabilise the nurse - doctor interaction, leaving nurses to practice their autonomy over initiating patient therapies, invariably involving medical devices. In terms of the nurse's account above, there is a marked difference in the command chain from the previous quote [Fn01], now it runs- nurse → doctor → initiated technologically derived therapy. To achieve this, the nurse has had to work at securing alliances, persuading doctors to acquiesce to the fact that through her long bedside vigil, which is another manoeuvre for network ascendancy, the nurse knows best for the patient. Constructing the nurse in this way, as central to network build efforts, throws up issues that need further explaining.

Firstly, are nurses, as autonomous agents, free to cluster other heterogeneous elements towards their own empire building goals? Secondly, what does this say about how nurses achieve an identity as ICU nurses? These questions, in fact, are interconnected. ANT addresses these issues by saying that although it may look like some actors present themselves as autonomous tacticians, with the wit and nerve to draw together and command the services of other elements in their networking aims, the truth of the matter is these same actors are dependent on the existing enrolment and stabilisation of surrounding elements to enable the power to build. Thus the concept of power in ANT is associated with forces of alliances within the network and not with individual actants (Law, 1999; Latour, 1996). In the same way, nursing identity building should not be looked upon as established through some internal subjective voluntarism. On the contrary, identity formation is similarly dependent on the inter-relationality of actant elements circulating in networks.

Therefore, in both quotes above, there are two forms of nursing identity defined in interaction with the technology. The first [fn01] sees ICU nursing as being able to respond and make sense of technological monitoring, converting machine knowledge into care interventions. The second nurse's [Fn09] identity is configured as an autonomous agent able to act independently of the medical staff when instigating therapies for patients. In each case however, nurses' understanding of who they are as nurses only appears in the world as the effect of relationality to other actant elements. This suggests that identities, rather than being fixed, are in fact mutable in relation to the other shifting elements operating within the network.

The last point returns me to the findings presented in chapter 5. In this discussion it might be appropriate to reconsider the technological dependency of nurses as in fact a relationality of co-dependency between nurses and all actants in the network. Thus, a technological problem, e.g. a clotted line during patient dialysis, becomes a nursing problem translated into a setback in the patient's recovery. Similarly, when confronted with the problem of patient dialysis nurses are compelled to comply with the requirements of blood filtration technology, including maintaining its functionality. In this respect, the machine, like many of the sophisticated medical technologies in the ICU, commands nurses' attention as an obligatory point of passage in the patient's treatment. However, this scenario, on closer inspection indicates a co-dependency between nurses and the technology they interact with. On the one hand the nurse requires the technology for patient care, and is thus obligated to perform their nursing tasks through it. On the other hand, the machine requires the co-opting of nurses, along with a host of other network components, technicians, consultants, tubes, patient blood, in order to carry on as a viable technology. Crucially, these states of network alliances are indeterminate and precarious, liable to be reconfigured at other points and in other contexts within the ICU networks.

In the same way, nurses' understanding of the situation is partial. From the perspective of any one of the actors involved in this interaction, the role of the nurse could look quite different (Singleton & Michael, 1993). However, this is what emerges in analysis when one follows the actors. It is the partial perspectives of all the heterogeneous elements that result in indeterminacy in networks and indeed leads to failure when attempting to secure analytical closure. The researcher could trace all the actants in the network to resolve the matter, however this would be a formidable task due to the rhizomatic form networks take; ever expanding into new territories of actant engagement (Dolwick, 2009). By following other actors, we find that at different temporal nodes in the network, others are trying to re-open black boxes and resist enrolment, which are all factors that lead to occasional network instability. A case in point from the findings in chapter 6 was when nurses disclosed that in their efforts to work with certain technology; doctors will undo efforts by asserting that particular devices were "random number generators." *Fn11, female nurse:* "Quite a lot of our consultants have lost faith in the information the machine gives them. We're actually using different machines now... So we very rarely use these machines anymore, because we've lost trust in the information they give us."

Consultants happen to be important components in the ICU network. Therefore, their disengagement signals a sizeable rupture in the efforts to stabilise routine use of the technology in cardiac care interventions. The LIDCO heart monitor, as a once stable technology used by ICU staff, has become untrustworthy. This fall from grace for this particular device has come about through subsequent innovations in cardiac monitoring. The interesting thing about the LIDCO's history is that, according to interviewed nurses, as a technology it has always been untrustworthy. The

nurses who were interviewed report that setting it up involves a series of invasive convolutions. When operating, it required regular re-calibration, and for all the effort on the part of ICU staff, it returned dubious monitoring results. Nonetheless, back in the day when its innovative features were viewed as the best in cardiac monitoring, it was able to draw together heterogeneous elements within the ICU towards ensuring its functionality. New devices and techniques in cardiac monitoring have caused the LIDCO black-box to be opened. The result is that alliances which held it together have now become unstable. However, the LIDCO remains the monitoring tool of choice in particular care scenarios, where some consultants favour it while others refute its merits. In science and technology studies this situation is the stuff of technological controversy (Collins & Pinch, 1998; Pickering, 1992).

ANT enables us to understand this situation as the inherent instability of actant enrolment. Indeed, characterising the LIDCO monitor as a 'random number generator' is now an effect (or outcome) of the precarious network built around the device. In addition, if we consider the LIDCO in terms of its immutability- its ability to remain constant in form and purpose across the network- then its shifting inscription from cardiac monitor to *random number generator* suggest that time and innovation has very much made this technology mutable. It has, semiotically speaking, changed shape, and taken on a new identity through its technological lifetime in the ICU.

But where does this leave nurses' understanding of the device, with regard to their identity-in-practice? Interestingly, the nurses somehow stand between intersections of network influence. On the one hand they are led to operate the monitor by particular consultants, while on the other hand other senior staff refute the usefulness of the machine. This results in nurses demonstrating ambivalence to their identity (as a network effect) in relation to their practice with this particular technology. As the quote above indicates, the nurse shares the reluctance of consultants to rely on the machine. It might be considered that this stance marks their refusal to remain enrolled in this particular machine network. If the alliances that surround the LIDCO have broken, it is due, I suggest, in some way, to nurses working to protect their role and standing as technologically astute actors: "*we very rarely use these machines anymore, because we've lost trust in the information they give us*". There are new alliances to be made with other devices. The problems of the old machines are now not the nurse's problem. Their interests lie with the capabilities of other technology to support their patient's care.

4.2 Nurses' Social use of Technology

I explored how nurses might use technologies in their interaction with other actors in the ICU environment. Here I was interested in the social affordances of medical technology beyond their actual technological function in the care of patients. For example, although nurses employ an array of monitoring devices to gather physiological information, the findings indicated nurses also used the technological information to mediate their status in relation to senior medical ICU staff. In addition, when nurses dealt with the death of patients, they again 'shaped' the semiotic qualities of technology in relation to patients relatives' expectations of bearing witness to the moment of death.

According to Law (2009), ANT recognises that technological objects can own layers of meaning which are open to appropriation by 'human' actants in their network building strategies. This is to say, the sign system in which nurses (and other ICU personnel) take their understanding from is one that is *necessarily* shared by all participants in the intensive care environment. I use the term *necessarily* to indicate that the world of ICU exists as a totality of meaningful practices, where the community participates in the collective circulation of meaning. Referring to this manifold of meaning, Suther (2006) describes it as the production of "intersubjective epistemologies" (p.318). Accordingly, meaning is created jointly in the interactions of group actors, but also actors can 'use' the shared meaning to mediate forms of interaction. Thus, the material 'reality' of the ICU is informed by the meaning-making practices of all who share the network environment. The technologies of the ICU are part of the semiotic or symbolic field in which nurses, consultants, patients and their relatives participate. As John Law (2009) states: "*We've seen that material-semiotics explores the enactment of realities, the ontological. We've also seen that it describes the making of knowledge, the epistemological.*" (p.154). Put another way, nurses are able to shape the symbolic meanings of technology to effect particular social interactions. When I presented the social affordances (Hutchby, 2001) that ICU technology offered, I was directing attention to the semiological qualities inherent in machines. In other words the machinery becomes a form of text or sign to be read. I would argue that nurses work to shape the technology as text to produce social effects. As Hutchby (2001) emphasises, "users ... may seek to produce readings of the technology-text that best suit the purposes they have in mind for the artefact" (p.445). So in the findings when the nurse talked about removing the technology from the dying patient, I indicated that the nurse was in effect mobilising a textual 'reading'. Wherein the removal of the technology signified to the patient's loved ones that the passage to death was perhaps imminent, and that they should bear witness to the actuality of the dying patient and not to any signs of death displayed in the technology. These insights from nurses' social practices surrounding death in the ICU have resonance with Timmermans' exploration of death in the emergency department (Timmermans, 1998). Timmermans also records that far from technological involvement effectively dehumanizing the social aspect of death (Moller, 1990), in enacted

resuscitation efforts, technological devices can mediate the transition of death, by affording space for relatives to come to terms with the death of the patient.

As the previous extract from the findings demonstrates, machines in the ICU environment are used not wholly in terms of their technological affordances. That is to say, social affordances move the uses of technological devices beyond the direct purpose built into them as part of their designated technological role. Those who design and manufacture technology work to secure a particular use of the technology: how it should be operated, who should operate it, and in what context. It is not that ICU nurses use technology incorrectly, but they might employ it to achieve other ends, which creatively extend the textual qualities of devices. In doing this, nurses open up a space, which engages the technology in the social contingencies of the world. Of course the idea of social affordances does not suggest that anything goes in terms of using the social element of technology, the logic of local practices in which the technology is placed in some way defines the limits of the social affordances of the technology (Hutchby, 2001). I am seeking, with this example to bring attention to how nurses as heterogeneous engineers are able to enrol machines into alliances in order to shape interactions with human and non-human actants. In some respects, the activities involved in network building amount to persuading and enrolling other actants on to networks. I reported in the findings that this is most notably achieved when nurses situate themselves as an obligatory point of passage, ensuring that other actants, namely doctors, have to engage with nurses to understand the patients' condition. *Mn03 Male nurse: "I'm not saying that I know better than the doctors, but I do think because I'm spending more time with the patient I am the best person to relay changes in their status condition... because I monitor them closely."*

The power/knowledge relationship, enacted through technology, gives nurses a level of status enhancement in the ICU. Thus, in the findings in chapter 6 where I discussed nurse-doctor interaction, nurses were able to challenge the treatment decisions of doctors, through their intimate knowledge of the patient's condition, provided through intensive monitoring. Once more, I would argue, nurses are appropriating the textual quality of machines beyond their technological affordances. This is to say, they use their position as knowledge providers in terms of the patient's condition, to mediate their social-professional status in relation to medical staff. For their part, doctors, consultants, and surgeons, as participants in the epistemological community, 'recognise' and indeed acquiescence the symbolic knowledge/power held by nurses, through their tacit acknowledgement of nurses' expertise. This interaction, as well as operating through the materiality of the ICU technology, also operates at the semiotic level, where signs, symbols, and texts flow in the circuit of meaning that makes up the ICU world. This analysis is similar to Carmel's (2006a) examination of the doctor-nurse relations in his study of the ICU. I agree with Carmel on the notion of a shared project of the ICU. However, my analysis suggests that nurses' use of technology-in-practice reveals, as with other examples presented in the findings, that the doctor-nurse relationship is mediated around the social, symbolic and crucially the material qualities of ICU technology. For example, ownership of the knowledge and information that the technology provides very much structures the status relationship of the two professions.

All this raises an interesting point in ANT analysis. The point I have been making throughout this thesis is that ANT usually assigns outcomes or effects to stable networks. Thus, it might be considered that an ICU nurse or a LIDCO machine materialises as an effect of a stabilised network of heterogeneous elements: designers, manufacturers, trainers, codes of conduct, technicians, power supplies etc. But what happens to the nurse as a network effect when a particular network untangles, when elements remove their enrolment or the dimensions of alliances shift? The answer is that nurses don't disappear. Instead, I would argue that the breakdown of networks produces further effects at other points in the web of association. Indeed, the suspension of particular network alliances instigates actants to reassemble elements, find new associations, and begin the work of stabilising new networks. So, the nurse's suggestion that the old filtration machines are "dying" can be taken as an effect of the destabilised network of elements that once surrounded it. Having observed the efforts involved in introducing the new technology to nursing practice, I can testify to the trials that nurses undergo in assimilating new forms of knowledge and expertise in to their practice. For a while, the network elements- amongst which are company representatives, training sessions, product manuals, and nursing protocols- will remain visible. However, in time, nurses will shape their understanding of the technology, and socialise the technology as an extension of their nursing practice and identity; whilst the stabilised heterogeneous elements will vanish into the background. The network, according to Law (1992): "[W]ill be replaced by the action itself and the seemingly simple author of that action. At the same time, the way in which the effect is generated is also effaced: So... that something much simpler... comes, for a time, to mask the networks that produce it." (p.5)

The simplicity that is arrived at in the normalising of nursing practice around technology, frames the technology as a neutral component in their endeavours to care for patients. Although nurses are involved in the minutiae of network activities, the complexities of the network arrangements are never wholly disclosed to them, through their actions. Furthermore, nurses in their everyday work do not recognise their network building strategies, or in fact, that they may be influenced by heterogeneous engineering strategies of a host of other actants, including technologies, pushing them this way and that way, enrolling them through unspoken interests. The findings disclose that nurses do

operate strategically, using their own power and influence to configure representations of patients. When looking through the lens of ANT, the network world of the ICU and nurses' understanding of it comes to the fore. Networks can be traced, to some degree, to enlighten nursing practice around technology in the ICU. Within Chapter 2 I examined various sources of science and technology and nursing literature, and agreed with May and Fleming (1997), and Carmel's (2013) argument that standard nursing theory may not serve its purpose. What nurses should do by way of prescribed theories of practice does not capture fully the boundary of ICU nursing in context. Where I differ with Carmel is in the mode of analysis of these fundamental socio-technical relations. My focus, although it touches upon many of the themes raised by Carmel, has been to find explanation for the changing practices of ICU nurses in the complexity of socio-technical arrangements. Carmel appears not to consider the radical consequences of technology upon nurses' social interactions with other actors in the ICU. Although he recognises the materiality of technology in the ICU, he eschews the nonhuman charisma (Lorimer, 2007) of technology to hold the same ontological forces as human actors (Carmel, 2003).

I, on the other hand, understand the force of technology in the ICU to mediate care interventions along with nurses. The ICU is a complex world; and to explore how nurses understand it, requires unravelling the complexity that involves both technological and social interaction. Not all nursing interactions around caring for patients on the ICU are technological, although they may appear as such on the surface. Likewise, analysis of supposed direct social (and political, economic) exchanges must admit the importance of technology as a mediator in those interactions. Returning to Timmermans and Berg's (2003) analysis of technology-in-practice, I have demonstrated the complexity of technological involvement in the ICU, and demonstrated that nurses' understanding and use of technology configures a great deal of the practice that goes on within the ICU. Moreover, nurses, in their interaction with the ICU technology nurses, are able to articulate the symbolic qualities of the technology. Through this articulation nurses subtly reconfigure both their own and patient identities. These identities are not static, but dynamic and mobile. Hence, I showed in the findings in chapter 7 that patients' identities are transfigured in socio-technical networks, as they move through the ICU care regime. They move from 'technological bodies' to 'social bodies' as an effect of the changing representations of patients constructed by nurses. This transfiguration comes about as a necessary component of both nurses and patients' reliance on network alliances with the life-saving technology; making it possible for the former to practice and the latter to survive.

4.3 Future Research Using Technology-in-Practice

Timmermans and Berg (2003) ask that future research of technology and medicine is alive to the creative interplay of actors and technology and the social context of interaction. In the last decade or so, the technology-in-practice model has informed the diffusion of technology in healthcare environments (Ulucanlar et al., 2013; Peiris et al., 2011; Harrison et al., 2007; Poland et al., 2005). These studies have looked at how technology has been adopted across a range of healthcare settings, ranging from hospitals to GP practices. At the same time, the UK health service, through the institutions of Health Technology Assessment and NICE (National Institute for Health and Clinical Excellence), has attempted, through protocol and guideline processes, to ensure the stable transition of new innovations into health practice. However, the guidelines given for diffusion have often been criticised for using the assumptions inherent in probabilistic science, and efforts towards the routinisation of practice around new technologies (Chalkidou et al., 2007). The message from technology-in-practice has been that technological adoption must be understood as presenting a complex interplay of social processes; technology innovation does not simply transfer from design to manufacture to practice in a straightforward linear progression.

In a recent study undertaken by Ulucanlar et al., (2013) the authors set out to inform the introduction of technology by placing diffusion efforts within the empirical world where the social context informs the adoption of technology. The important message from this work is that to understand the successful adoption of new technologies, the researcher must undertake a sociological analysis of how technology is taken up in the world of health care. Ulucanlar et al., concurring with my theoretical perspective, use ANT as a lens to provide a framework which includes investigating the social identity of both technology and humans as a valuable indicator into technological adoption by healthcare organisations. Ulucanlar et al., (2013) have identified that the: "*Adoption processes are strongly socially mediated by technology identities: a set of composite and contestable attributes that give each technology a distinctive, if contingent, character. Identities reflect actors' social orientation and the cognitive necessity to define and imbue with meaning other actors, including... the nature of the technology itself and its material properties.*" (p. 103)

In conclusion, I recommend that research and policy guidelines reflect the complex and contingent nature of socio-technical network arrangements. Any prior assumption about how technology will interact with individuals and organisations should be laid aside. Emphasis in policy guidelines should be on understanding the co-configuration of human and technological identities. Ulucanlar et al., (2013) have developed a useful framework which articulates the uptake of machines beyond their technological usefulness, as devices that enable identities of use. However, what is

not clearly understood in the findings presented by Ulucanlar et al. is the possibility of reciprocity of identity construction in the interactions between professionals and machines. In my study, however, there is a thread throughout that alludes to the ideas that through their understanding of technology, nurses adopt and play out forms of identity in relation to socio-technical networks. In relation to my thesis, future research on ICU nursing and technology adoption might consider the possibility of socio-technical interactions to configure positive nursing identities as a strategy for technological adoption in the ICU.

5.0 CONCLUSION

This thesis set out to explore ICU nurses' understanding of technology, and sought to answer the questions: In what way does nurses' understanding of technology in the ICU mediate their use of this technology? Do technology and technological regimes shape nurses' ideas and representations of patients, and the forms of care they provide? In order to investigate these questions I used an ethnographic approach, informed by ANT. Using this theoretical approach my aim was to investigate technology-in-practice, to pick up on the nuanced socio-technical interactions between nurses and technology. I found that by taking this approach I was able to gain a picture of how at one moment nurses' understanding of technology revealed their dependency on the technological arrangements in the ICU in order to care for patients; whilst at other points, nurses used the technology to mediate social interactions with others to achieve socially significant outcomes. However, when analysing these interaction moments it was important to understand that nurses' dependency upon, and social shaping of technology were a dynamic feature of the socio-technical interactions of a whole array of heterogeneous elements operating in the ICU network.

A further message from this study was that nurses' interactions with technology provided an opportunity for nurses to construct a number of metaphorical identities: as 'mini doctors', 'scientists', and 'technicians'. These identities, I argued, were an outcome effect of the socio-technical networks that make up the ICU. A technology-in-practice approach, such as ANT, with its interpretive flexibility allowed the dynamism of real world interactions to emerge from the data. I have argued that ANT provides an important means to make sense of the data, and have suggested future research using an ANT as a technology-in-practice perspective might focus on how nurses' identities in particular might be shaped by technology. Also, how in turn, nursing identities constructed in socio-technical network interactions, might inform the adoption of new technologies in the ICU.

In closing, I believe the findings presented in this thesis add to an understanding of the complexity of technology diffusion and implementation in nursing practice in the ICU. My sociological account casts light on some of the complex interplay between nurses and technology. Modestly, I hope that these insights

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