**Nurses’ Understanding of Health Technology in the Intensive Care Unit**

**Brian Crosbie**

**Thesis Submitted for the Degree of Doctor of Philosophy**

**School of Health and Related Research**

**Faculty of Medicine**

**University of Sheffield**

**January 2014**

# 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.

# Contents

[**Abstract** 2](#_Toc379158974)

[**Contents** 4](#_Toc379158975)

[**Figures and Tables** 7](#_Toc379158976)

[**Chapter One- Introduction** 8](#_Toc379158977)

[Nurses’ understanding of technology in the intensive care unit 8](#_Toc379158978)

[The technological terrain of the study 15](#_Toc379158979)

[Defining ICU technology 15](#_Toc379158980)

[Nurses’ understanding - defining the research questions 23](#_Toc379158981)

[**Chapter Two- Literature Review** 26](#_Toc379158982)

[Defining technological standpoints 27](#_Toc379158983)

[A framework of medical technology 29](#_Toc379158984)

[Technological determinism 30](#_Toc379158985)

[Social essentialism 32](#_Toc379158986)

[Technology-in-practice 37](#_Toc379158987)

[Actor-Networks as a theory of technology-in-practice 39](#_Toc379158988)

[Technology and nursing research 44](#_Toc379158989)

[Expanding the concept and role of technology in nursing 47](#_Toc379158990)

[Nursing professionalisation 48](#_Toc379158991)

[The two professions and the boundaries of ICU 53](#_Toc379158992)

[Nursing Identity 61](#_Toc379158993)

[**Chapter Three- Methodology** 64](#_Toc379158994)

[Epistemological assumptions 64](#_Toc379158995)

[Accessing the field of ICU nursing 67](#_Toc379158996)

[Participant recruitment and interview strategy 71](#_Toc379158997)

[Observing the ICU 74](#_Toc379158998)

[Ethical concerns 78](#_Toc379158999)

[Analysis of the data 80](#_Toc379159000)

[Emerging methodological issues 84](#_Toc379159001)

[Layout of the Findings 86](#_Toc379159002)

[**Chapter Four- Findings** 88](#_Toc379159003)

[The observation study on the ICU 88](#_Toc379159004)

[The hospital environment 89](#_Toc379159005)

[Entering the ICU 93](#_Toc379159006)

[The ICU environment 101](#_Toc379159007)

[Technologies on the ICU 105](#_Toc379159008)

[The intensive care bed 106](#_Toc379159009)

[The ventilation machine 110](#_Toc379159010)

[The blood filtration machine 111](#_Toc379159011)

[*Prismaflex*- the new state of filtration technology 116](#_Toc379159012)

[The ICU main entrance: negotiating a hygiene boundary 126](#_Toc379159013)

[**Chapter Five- Nurses’ Technological Dependency in Practice** 134](#_Toc379159014)

[Looking after organs 136](#_Toc379159015)

[Chasing numbers 140](#_Toc379159016)

[Balancing the patient through technology 152](#_Toc379159017)

[Hermeneutic devices and nurses’ understanding of patients 161](#_Toc379159018)

[**Chapter Six- Nurses’ use of technology: strategies beyond dependency** 170](#_Toc379159019)

[Nurses’ and Doctors’ technological relationality 173](#_Toc379159020)

[Nurses’ and relatives’ encounters with technology 184](#_Toc379159021)

[Technology and death in the ICU 189](#_Toc379159022)

[Ethical care in the realm of technology 197](#_Toc379159023)

[**Chapter Seven- Patient representations through technological care** 205](#_Toc379159024)

[Technology compliant and resistant patient-bodies 208](#_Toc379159025)

[Technological and social patient-bodies 213](#_Toc379159026)

[Techno bodies to social patients and nurses’ network building 218](#_Toc379159027)

[ICU nursing vigils: care, technology and patients 225](#_Toc379159028)

[ICU Nursing and the care vigil 226](#_Toc379159029)

[Technological vigil, the return of the devices 230](#_Toc379159030)

[**Chapter Eight- Discussion** 237](#_Toc379159031)

[Nurses as dependent actants in networks 239](#_Toc379159032)

[Nurses’ social use of technology 249](#_Toc379159033)

[Future research using technology-in-practice 256](#_Toc379159034)

[**Conclusion** 258](#_Toc379159035)

[**References** 261](#_Toc379159036)

[**Appendices** 275](#_Toc379159037)

[Appendix A- Letter of invite to participate in interview 275](#_Toc379159038)

[Appendix B- Information sheet for interviewees 276](#_Toc379159039)

[Appendix C- Information sheet for observations 280](#_Toc379159040)

[Appendix C- Interview Schedule 284](#_Toc379159041)

# Figures and Tables

[Figure 1: Plan of the ICU 96](#_Toc378880759)

[Figure 2: Typical ICU bed with monitor and driver on stand 102](#_Toc378880760)

[Figure 3: Ventilation machine 106](#_Toc378880761)

[Figure 4: Aquarius ventilation machine 107](#_Toc378880762)

[Figure 5: Close up, filtration tube pathway 107](#_Toc378880763)

[Figure 6: London Underground map, Harry Beck 1931 108](#_Toc378880764)

[Figure 7: Diagram of circulatory system 108](#_Toc378880765)

[Figure 8: Prismaflex- highlighting the technology in renal physiology 113](#_Toc378880766)

[Figure 9: Prismaflex- highlighting the technology in nursing care 114](#_Toc378880767)

[Figure 10: Prismaflex dialysis machine 116](#_Toc378880768)

[Figure 11: close up of filtration apron 116](#_Toc378880769)

[Figure 12: Model of nurses' representation of patients 200](#_Toc378880770)

[Table 1: Categories of health technology and examples 13](#_Toc378880911)

[Table 2: Technology within intensive care 16](#_Toc378880912)

# Chapter One- Introduction

## Nurses’ understanding of technology in the intensive care unit

Health technology, as an adjunct to nursing care, has burgeoned over the last 50 years. From monitoring devices (Sandelowski, 1997) to computer based patient informatics (Timmons 2002; Ash, Berg et al. 2004) much of modern nursing care would be unimaginable without technological innovations (Walters, 1995). This is particularly so in intensive/critical care nursing, where the development of critical care nursing practice, and the growth in expertise and professional status, has come about as a consequence of health technology developments (Barnard, 2007; Sandelowski, 2000).

This growth in health-based technology mirrors the substantive development and deployment of technology in many areas of modern life, both at work and play. Today, more than in any other period, technology extends throughout our everyday activities. Technology pervades, in a qualitative sense, how we interact and do business with other social beings. As Giddens (1990) suggests, the rise of technology, coterminous with modernity, should be examined for both its *extensionality* and *intentionality* in modern living.

With a tendency for technology to encroach upon our everyday arrangements, commentators have examined the effects of technology on social existence. In general terms, a tension has emerged between those commentators who write about the determining tendency for technology to dehumanise social interaction (Braverman, 1974; Marcuse, 1964) and those who argue for technology as something which can enhance our lives. With a litany of labour, life, and environmental-saving devices, technology marks, for some, the highpoint of human progress (Feenberg, 1999; Hadjilambrinos, 1998).

If we accept that technology and its interaction in material sociality is widely contested then it is unsurprising that the application of medical technology garners comparable uncertainties. Indeed, many of the wider social anxieties (and for that matter hopes) placed upon technology are mirrored in the application of technology in medicine. To offer a pertinent example, whilst it is technology that makes much ‘intensive care’ possible, there still remains some degree of ambivalence and uncertainty about the appropriateness of technology in relation to patient care (Fairman, 1992).

Given that nursing and medicine have historically been sites for the adoption of new forms of technology (Sandelowski, 2000) it is surprising that technology in nursing has been relatively under researched (with the exception of some work in nursing philosophy (Barnard, 2007; Sandelowski, 1999; Walters, 1995). More notable still, that battles between medicine and nursing have been fought and won over the siting and use of technology and have contributed to nursing gaining professional status (Davies, 1995). One route to a new professionalism has been through shaking off the less than ‘scientific’ approaches of the past and in embracing technological developments. However, like all social practices, nursing is a contested field with a set of ‘unresolved issues and … tensions’ (Davies, 1995, p.13), none more so than the major cleavages in nursing philosophy around the role of technology and it transformative qualities (Barnard & Sandelowski, 2001; Barnard, 2000; Sandelowski, 2000; Walters, 1995). The major moral and philosophical debates surrounding the place of technology within nursing coalesce around a number of oppositional questions:

* Does the use of technology determine the practice of nurses?
* Alternatively, are nurses in control of the technology?
* Does the application of technology in nursing practice enhance holistic patient care?
* Or does technology detract nurses from patient care towards a focus on technological maintenance, resulting in nurses/patient alienation (Barnard & Sandelowski, 2001; Purnell, 1998)?

These questions are perhaps inherently tied to, and formulated within, a macro examination of technology which seeks to ‘ground them in a broadly societal context’ (Hadjilambrinos, 1998, p.179). Moreover, examined through the lens of ‘technological regimes’ that operate at the macro level, the answers will inevitably fall on either side of this debate; reflecting views on technology as either somehow harmful to human interaction and sociality, or on the other as an enhancement to social interaction by way of technological progress (Hadjilambrinos, 1998).

In contrast there have been attempts to examine nursing practice at the micro level of human/technological interaction and to unpick the subtle and nuanced way that nurses articulate their use of technology. Crocker and Timmons (2009) explore the transformation of ‘medical technology’ into ‘nursing technology’. They show that the means of transformation is context dependent for nurses, influenced by recourse to professional status, the articulation of moral discourse surrounding nursing care, and also to perceived differences between novice and senior nurses’ use of technology. While novices were determined by technological protocols, senior nurses were able to transform the technology through their professional agency and to adapt it to what they perceived to be appropriate utilisation in nursing care. This example from health technology research within science and technology studies demonstrates that a more nuanced understanding of human/technological interaction requires the micro exploration of the immediate context of technology use. Recent studies in health technology have coalesced around the idea of technology-in-practice (Timmermans & Berg, 2003; Orlikowski, 1992), developed as a way to explore the contingent and emergent nature of both social and technological systems. This will be considered further at a later point in the literature review chapter. For now it is sufficient to indicate that this standpoint holds promise by offering a theoretical through which to explore how nurses come to understand and enact their professional identity (Lehoux et al., 2008) and place meaning on their interaction with technology in pursuit of caring for patients.

At this juncture I should disclose my interest in looking at ICU nurses’ understanding of technology. The idea for this study originated 15 years ago as a sociology undergraduate at Edinburgh University, although my interest for the work of nurses’ reaches back earlier to a period when working as a nursing assistant within psychiatric care. During my degree an interest in science and technology studies was born. Prior to undergraduate study I had always considered technology, gadgets, and indeed most physical objects as mundane entities, their only importance being that they could make life easier if they worked, or make life more complicated if they did not. Machines and devices stood in my mind alongside people, helping or hindering their activities and interactions, but nothing more than that.

Choosing senior honours courses in sociology I became curious about a course called ‘Technology and Society’, intrigued with what this had to do with understanding sociology. Delving in to the world of technology I thought would make an interesting diversion amongst those other courses selected (social theory, methodology, gender studies, etc.) and would provide some real-world knowledge alongside more traditionally academic concerns. Surely a focus upon technology and its relation to science and engineering could be nothing but practical and straightforward?

Evidently ignorant of the Edinburgh School’s reputation in science and technology studies I attended seminars run by David Bloor, John Henry, Martin Kusch and others (all key players in science and technology studies at the time) and was fascinated by the insight that they offered. The teaching of Donald Mackenzie I found particularly inspiring.

In Professor Mackenzie’s course ‘Technology and Society’ I experienced a turning point in my sociological interests. Here I was introduced to some new and profound theories which seemed to answer a number of hanging question that had not been resolved in the rest of my studies. This had a major impact upon me as an undergraduate as I felt the theories and epistemological understanding from this field could be applied to areas of social life out with technology studies. All material life became an engagement with some form of technology and I learned that there was more to human relations with technology than a striving for greater efficiency. Seen through the various theories of technology and society I now understood how technology shapes our world, mediates our relationships with other humans, and crucially mediates our relationships with other objects. In making this revelation I wanted to bring these insights to the fore and explore an area of technology and social life with which I was familiar, which brought me nursing and technology.

Although I had worked for five years as a psychiatric nursing assistant, plus many years working in social services, I am not a qualified nurse. My investigation of nurses’ interaction with medical technology is therefore not borne of some necessity to understand the role of medical devices as part of any vocational will to power. However, my previous quasi-insider status does provide sufficient engagement and insight to recognise an important nexus of technology and the social. The world of the ICU is replete with technological material and as a student of technology and society this seemed an appropriate site to explore the interaction of humans and technology. A site where at first glance we might presume that nurses’ use of technology would be relatively instrumental: technology as tools applied to nursing practice to make patients better, a relatively straightforward situation where if the nurse follows the manual the machine does what it says on the tin as it were.

From the outside there seems nothing specifically sociological with this practical interaction. If sociology can engage with ICU nursing then it is only in as much as nurses share and interact in the space of the ICU environment, and within this perspective it is strictly human-to-human interaction that is the concern of social analysis. The connection between supposed (non-social) mechanical objects and their social contexts of application has hitherto marked a sociological boundary for early thinkers of science and technology studies such as Robert Merton (1973). However, in my academic studies I had come to understand the relations of nursing and technology to be more complex. With the rise of new theoretical perspectives, not least the Strong Programme within the Edinburgh School of science studies (Bloor, 1991), research on technology could go further by breaking down the boundary between the objective practice of science and technology on one hand and social interaction around this practice on the other. Henceforth, the new theories of technology and society would allow an examination of the social constituents of brute machines and indeed the constitution of social relations by technology.

As Carmel (2013) indicates the idea of nursing is bound up with notions of holistic care. I am interested to explore this normative view of nursing practice. To consider how it plays out in the technological world of the ICU and is maintained (or re-configured) against a backdrop of public discourses on technology which suggest that care may be undermined in the context of high technology. I also wanted to look at how nurses understand the technology and how they might use it in creative ways that contribute to the social interactions going on in the ICU.

In sum, my goal is to explore the possibility of a theoretically informed explanation of those interactions in the technology nursing nexus. I find many of the theoretical perspectives surrounding the construction of technology (social or otherwise) fascinating and my study allows the opportunity to exercise elements of this theoretical canon and to see how far they can travel in my examination of technology in nursing practice. Along the way I hope it proves useful in illuminating the interactions of nurses.

## The technological terrain of the study

In this section I will define the empirical field in which this research will take place. I will lay out the rationale for why ICU nursing is an important focus for understanding nursing care in locations of high technology. However, before considering these points it is necessary for me to define the limits of the ICU-based technology that will be the focus of investigation. Therefore I will outline types of ICU technology before setting clear boundaries on the specific technologies that will inform the scope of the study. In the last section I will offer the research questions which will become the focus for the rest of the thesis.

## Defining ICU technology

There are numerous devices, artefacts and materials which fall into the realm of health technology, indeed the diffusion of technology in healthcare seemingly increases unabated as new devices, techniques and procedures become established as part of standard practice. Acceptance of this new technology is governed by an array of social actors including health experts and the media who might champion the adoption of new medical devices (Lehoux, 2006), however, against a backdrop of rapid diffusion commentators have emphasized a cautionary message about the lack of effective evaluation of the use and purpose of new technology (in part due to its rapid uptake) (Lilford, 2000; Mowatt et al., 1997). Mowatt et al. recognise numerous examples of, “unevaluated new technologies that have diffused widely and have subsequently been shown to be ineffective or even harmful” (p.15). Although health organizations have a commitment to increasing the use of health technology within ICUs few of these technologies have been scrutinized in random controlled trials to test their effectiveness in reducing hospital mortality (Bastos et al., 1996).

Caution expressed by researchers aside, the fact remains that health technology has become an inescapable factor in care practices across all fields of health. The following table (1) taken from Lehoux (2006, p.xvii), although not exhaustive, gives an indication as to the wide scope of health technology.

|  |  |
| --- | --- |
| **Health Technology Category** | **Examples** |
| Screen tests | Cytological tests, blood tests, prenatal testing, genetic testing |
| Diagnostic tests and imaging devices | X-rays, ultrasound, magnetic resonance imaging, computer tomography |
| Implants | Cochlear implant, pacemakers, heart valves |
| Surgery/ therapeutic devices | Hip replacement, laparoscopic cholecystectomy, radiation therapy |
| Palliative technology | Ventilation, dialysis, syringe drives, profusion devices, nutrition |
| Health promotion technologies | Vaccines, condoms, public health initiatives, sports and exercise facilities |
| Information technologies | Telemedicine, electronic patients records, expert systems |

Table 1: Categories of health technology and examples

As the above table shows each area of healthcare has its own specialist technologies. Although it is important to note that some technologies demonstrate more generic application across a multitude of healthcare settings and clinical fields, the ubiquity of informatics and electronic patients being one such example.

With regard to the technology that will be considered in this study I wish to make a distinction between ‘hard-technology’ and ‘soft-technology’.

‘Hard-technology’ are those freestanding devices and machines used by nurses to help maintain and monitor the vital physiological and biological body functions of patients (see table below for examples). Used in the optimization of patient care and recovery they constitute a growing, and sometimes overwhelming, arsenal of equipment utilized by ICU nurses in their routine care practice (Donchin & Seagull, 2002).

Soft-technologies comprise computer software programmes which ICU nurses use as part of their administrative and patient management duties. At its core soft-technology represents a host of computer-based software developed for, amongst other things, the recording and retrieval of electronic patient records. In addition to the new format of record keeping the last two decades have seen an expansion of other forms of nursing informatics (Saba, 2001; Henry, 1995; Romano & Heller, 1990). The American Nurses Association (2008, p.3) define nursing informatics as, “…[A] specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, knowledge and wisdom in nursing practice”. The growth of internet-based technology has generated a wealth of diagnostic information which is available to nurses and raised expectations that nurse practitioners will utilize this store of knowledge to inform patient treatment, for example in the burgeoning area of risk prediction modelling (Rosenberg, 2002).

Although these two forms of technologies are in some instances considered together under the general expansion of health technology this study makes a clear distinction between them and focuses exclusively upon ‘hard technologies’. ‘Soft’ technology and informatics are acknowledged as important components of nursing technology research (see Jensen et al., 2009; McCormick et al., 2007; Smedley, 2005) but it is not the focus of this study.

Given the amount of technology in use in health care it is necessary to demarcate the technological terrain of this study. This study will consider solely that technology which is most often applied in intensive care units, specifically those devices and machines that ICU nurses use as part of their everyday practice in supporting patient care. The following table (2) taken from Bastos et al. (1996) provides a list of available technologies used within intensive care units, although it is of course sensible to note that technology use varies from patient to patient and that patients may be exposed to single or multiple technologies at any one time.

**Table 2: Technology within intensive care**

Electrocardiograph monitor

Pulmonary artery catheter

Tran venous pacer wire

Defibrillator

Intubation equipment

Infusion pumps

Continuous positive airway pressure apparatus

Mechanical ventilator, volume

Cardiac pacemaker

Ventilation device

Pulse oximeter

Doppler ultrasound

Portable electrocardiograph

Haemodialysis

X-ray (portable)

Intracranial pressure monitor

Ventriculostomy (monitor)

Continuous arterial-venous hemofiltration

End-tidal CO2 monitor

Intra-aortic balloon pump

Whilst the above list was derived from a paper laying out current technology circa 1996, it is a given that new technology trails are a constant feature of intensive care medicine (Baldwin, 2002).

Through their use these devices represent a series of practices, interventions, and procedures carried out by ICU nurses. At any given time nurses are monitoring and recording the ‘pulse’ of technology as a proxy for patients’ human physiological status. Indeed technological competence displayed by nurses in monitoring patients in this way is, in many respects, *the* demonstration of a nurse’s competence within ICU treatment (Wilkin & Slevin, 2004; Locsin, 1989). In their study looking at the meaning of caring among ICU nurses Wilkins and Slevin (2004) indicate that, “acquiring technical competence, knowledge and professional experience” (p.54) was viewed as a step to becoming confident ICU carers.

The rationale for exploring those particular technologies that interact with, and in some instances maintain, physiological and biological functions is to ‘get up close’ to nurses’ experiences of the human/technological interface. At this level things start to get interesting in terms of the boundary between patients and technology - for nurses in the ICU a constant focus on the machine-human interaction marks this site as a liminal space where they are neither fully focused upon the patient nor fully absorbed by the machinery. Barnard and Sandelowski (2001) in their study of humane care and technology put this interactional feature in this way:

*“Although it is common to categorize technology as nonhuman, pacemakers and artificial joints implanted in living human beings… regularly confront us with the reality of and potentiality for living artefacts and vital machines. These cyborg [elements]… blur the line between animate and inanimate, and human and machine.”* (p.368)

Barnard and Sandelowski use the term ‘cyborg’ to define the interplay between the human and the technological, although they also suggest that establishing a boundary between technological care and humane care is misleading. They argue that technologies’ supposed de-humanising features are neither universal nor inherent in the application of machines to human care. The notions of technology, nurses and patient are all socially constructed. Taking up a social constructivist/ social shaping position Barnard and Sandelowski (2001) view the meaning of technology as deriving from its context of use. Research must, they insist, stand back and take notice of the context and interaction between nurses and machines and describe the micro interactions between actors (I include nurses, patients and machines as actors in this interplay). Only in the unfolding of action can we assess the impact of technology upon the understanding and meaning nurses bring to their caring practices.

This I believe is an interesting conceptual space in which to explore the experiences of ICU nurses. For, if there is indeed an unbounded space existing between patients and technology, then this has to be mediated by nurses through their representation of both the technology and the patient. This mediation brings to the fore questions about identity both for the patient and nurse, irrespective of whether or not in the interface between patient and technology (a space of blurred representation) the patient’s social identity is lost. In terms of nursing care in ICU environments the question to ask is ‘what is being cared for?’ At the same time through the interplay between patient, technology and the nurse we may also ask who is doing the caring. Thus it may also be contended that the nurses’ identity is also configured in the unfolding interactions between the patient and technology (Lehoux et al., 2008). In this respect the interplay of both patients and nurses with technology represent the hybrid nature of human and technological interactions (Lapum et al., 2012).

Donna Haraway (1994) also invoked the spectre of the cyborg but hers is a space for play that permits new techno-human identities that transgress representations of hitherto subordinated (feminist) identities. However, in their research on death in intensive care Johnson et al. (2000) suggest that contrary to Haraway’s utopian enterprise patients might equally experience a fundamental loss of identity. The authors state that:

*“The body, encumbered by invasive equipment transfigures the patient into a cyborg of sorts, making his or her humanity and biological self less recognizable.”* (p.284)

In the realm of medical and nursing technology I believe that these points where human and machine coalesce present a vertiginous experience for nurses as they work through their care-giving priorities - between technology and patient. There is, I believe, a call to investigate ICU nurses’understanding of the relationship between machines and humans when, as has been suggested from previous research, there is a blurring of the distinction between human physiological status and technological monitoring.

## Nurses’ understanding - defining the research questions

This thesis explores nurses’ ‘understanding’ of technology. What then do I mean by nurses’ ‘understanding’? I use the term to define two aspects of nurses’ interaction with the ICU environment. Firstly, how nurses comprehend the activities and practices in which they are involved and are thus able to explain their actions and derive meaning from the actions of others. In this way, the world of ICU is meaningful to them as a shared (though at time contestable) set of practices, culture of artefacts, signs and language which all participants have a hand in re-producing. If they are asked a question or if something is pointed out to them, in terms of their interaction with technology, they would be able to explain through language what a given set of affairs means to them. Secondly, understanding describes their ability to produce and re-produce the world of ICU as a set of embodied practices which could be said to be pre-cognisant, i.e. without conscious thought, which nevertheless respond to meaningful signs - akin to Polanyi’s (1962) idea of tacit knowledge. It is a level of ‘understanding’ that takes its shape through embodiment in relation to the material world of ICU technology. The embodied nurse in interaction with technology ‘knows’ the permissions and prohibitions, knows where they can and cannot go in technology assigned space. This, however, does not limit the possibility for spaces to be reconfiguring; spaces have contingent properties and are changeable (Bingham & Thrift, 2000).

Similarly, in the semiotic world, all actions in context, including those of ICU nurses, have a textual quality which can be ‘read’ for meaning (Law, 2009; Grint & Woolgar, 2000). Therefore, when I write about nurses’ ‘understanding’ I have two properties of understanding in mind: one carried in mundane and everyday thought and language, the other within a complex flow of embodied actions corresponding to nurses’ tacit understanding of signs and symbols in indexical meaningful contexts. Sonesson (2007), in his exploration of embodiment and semiotics puts it like this:

*“We shall say that what is of primary importance to semiotics is operative knowledge- i.e. knowledge that must exist at some, probably low, level of awareness in order to render behaviour as understandable (and thus explainable)”.* (p.7)

There are methodological and epistemological implications for this use of ‘understanding’. Above, I mentioned two properties of nurses’ understanding. The first is acquiring through nurses’ accounts of their understanding of a situation, which is best achieved through in-depth interviews, which I used for data gathering. Here, understanding of a given interaction is expressed through verbal communication. The second, more speculative property is that through observational techniques I can explore the embodied understanding of nurses in the meaningfully co-produced space of the ICU.

With these details on understanding discussed, the purpose of this study will be to explore nurses’ understanding of technology in the ICU, and how the application of health technologies informs nurses’ professional epistemologies (Edgley et al., 2009) with regard to the care they offer patients. The specific questions to be explored are as follows:

* In what way does nurses’ understanding of technology in the ICU, mediate in their use of the technology?
* Does technology mediate nurses’ ideas and representations of patients and the forms of care they provide through technological regimes?

# Chapter Two- Literature Review

This review covers three distinct areas pertinent to the exploration technology and ICU nursing. Firstly, I will explore and review a number of theoretical perspectives or standpoints that have driven much of the literature and research on technology and society. To frame this literature, and the theory explained therein, I will adopt a threefold taxonomy developed by Timmermans and Berg (2003). Their framework is particularly useful as its focus upon research in health technology is supplemented by the authors’ consideration of wider theories and debates from the field of Science, Technology and Society (STS). My purpose with Timmermans and Berg’s classifications will be to expose some of the explanatory weaknesses that are bound up in adopting the first two of the authors’ classifications - technological determinism and social essentialism. In doing this I will follow the authors’ suggestion that any thoroughgoing research requires an exploration of technology-in-practice. In this respect, I agree with their conclusion and therefore consider Actor-Network Theory (ANT, hereafter), as an example of Timmermans and Berg’s third category of ‘technology-in-practice’, as a lens with which to explore nurses’ understanding of technology in the ICU environment.

I follow these classic theories of technology by looking at material concerning the implications of technology for nursing practice, considering here a body of work generated by nursing scholars. It will be seen that the technology standpoints outlined in the first section have informed the arguments for and against the use of technology in nursing care.

In the third section I will look at the literature pertaining to nursing as a profession. The classic position in the literature is that nursing has to a great extent remained subordinate to medicine, particularly in the context of the hospital. However, recent material has contested this as nursing academics have strived for theories and models of practice which are different to those applied in medicine. Nursing is about care not cure; it is about holism and not the objectification of patients. In practice, however, it may be difficult to conceive of nursing as a singular discipline (May & Fleming, 1997) . With this in mind, I will go on to look at how the literature conceives of medical technology as a mediator in the construction of nurses’ identities and care practice. Critically however, I suggest that this literature never fully engages with the actuality of technology-in-practice. By understanding nurses’ practices around technology we will find that medical devices have a role to play in the configuration of those practices and contexts beyond being mere conduits to nursing practice.

## Defining technological standpoints

From their previously marginalised position in social science, technology and science have emerged as areas for sociological investigation in the last fifty or so years (Feenberg, 1999; Woolgar, 1988). Prior to this few writers, with the exception of Marx’s (1867) writing on industrialisation, capital and historic development, explored the ontological import of technology within human activity - a lacuna that with hindsight now appears extraordinary given the ubiquity of technological devices in human history. It was not until the late modern period that scholars considered technology as a mediating phenomenon in social life. The turnabout in the socio-technical insights of commentators was as a consequence of increasing prevalence of high technology in both work and everyday life. Of course, technology had been part of craftwork (and nursing) since pre-modern times.

Two rival positions emerged with contrasting views on the influence of technology upon human conduct. On one hand technology was regarded as neutral with humans in control of technology for the benefit of social progress and individual happiness. Thus, for example, innovations in industrial efficiency would increase productivity, heralding a new epoch of technologically-enhanced prosperity for all (Graham, 1998). Others viewed technology as a determining monolith which in time would pervade all human endeavours. Even the ideas that shape human goals would be determined by the rationalisation of means brought about by technology (for an overview of these positions, see Feenberg, 1999).

Nursing, especially ICU nursing, has not remained free of these technological arguments, indeed the conflicting perspectives of technological neutrality and determinism have entered the canon of nursing research (Barnard & Sandelowski, 2001; Barnard, 1997, 1999). Barnard warns that technology in nursing does not assure linear progress, although science and technology may achieve medical efficiencies. Nevertheless, Barnard wishes to point out, in somewhat deterministic fashion, that the pursuance of technological progress in relation to nursing practice does bring with it changes in nurse/patient relationality. Barnard (1999) insists that:

*“The act of including machinery and equipment in nursing introduces patterns of techno-logical activity that by their very nature change nursing practice, our roles and responsibilities, and the way we organise our profession and patient care.”*  (p. 436)

However, throughout the last century developments in these perspectives have given rise to more nuanced reporting of technology’s role. It is therefore pertinent to investigate how the refinement of theories is encapsulated in research into technology and nursing and medical practice.

## A framework of medical technology

In their broad review of medical technology Timmermans and Berg (2003) define three approaches adopted in the sociological literature to investigate medical technology. I will use this taxonomy to explore the literature on classic technology in society. Timmermans and Berg’s definitions are then used to draw out the particular conceptualisation employed in research concerned with technology in the field of nursing practice. Although it should be noted at the outset that a great deal of the nursing literature on technology involves writers, consciously and unconsciously, ‘black boxing’ technology (Callon, 1989): where the devices mentioned are pre-configured in the analysis as ‘closed’ and incontestable objects. Indeed, in much empirical ICU nursing research the focus is confined to the social activities of nurses with scant regard to the impact of machines in forming the nursing activity (McConnell, 1990). Framing technology in such a fashion is indicative of a position of technological neutrality. However, as I will suggest towards the end of this section, beneath the surface of technological neutrality there are considerable power relations operating around technological artefacts.

The technology perspectives discussed by Timmermans and Berg (2003) are based upon wider scholarship from science and technology studies, scholarship which is highly pertinent to the world of medical technology. The three approaches to technology Timmermans and Berg address are, “technological determinism, social essentialism, and technology-in-practice” (p.99). I will discuss each approach in turn.

## Technological determinism

The technological determinist perspective holds that technology determines the interplay of social activity**.** From this theoretical standpoint technology enters society transforming the ways in which people mediate relations among each other (Webster, 1991). This determinism extends to economic, political, as well as social arrangements. As a standpoint this somewhat oversimplified perspective is captured in ideas of raw cause and effect relations, where technology wholly mediates interaction causing the setup of prescribed worldviews. As a uni-directional approach, from machine intervention to human change, technology is itself un-mediated by the very social arrangements it instigates (MacKenzie & Wajcman, 1999). In its radical form, expressed in the work of Heidegger (1975), the determining quality of technology not only manifests in social action, but also dramatically determines the thoughts and values that define social action. Thus, according to Heidegger (1975), the essence of technological advancement in modernity ensures a tipping-point where technology heralds a new world-view in which rational calculation becomes the appropriate solution to the problems facing societies:

*“Everywhere we remain un-free and chained to technology, whether we passionately affirm or deny it. But we are delivered over to it in the worst possible way when we regard it as something neutral; for this conception of it, to which today we particularly like to do homage, makes us utterly blind to the essence of technology”.* (p. 4)

Although Heidegger’s view appears overly pessimistic writers have commented that the techno-rationalisation of society has had more impact as an ideological feature than as an empirical fact of modern living (Feenberg, 2005; Centeno, 1993).

Against the background of the technological determinism debate, in the field of medicine and nursing the general determinist perspective has fuelled debate across the spectrum, between those that view technology as objectifying the nurse patient relationship (Donchin and Seagull, 2002) and those that believe machines can help the subjective inter-relations between nurses and their charges (Verhulst, 2008; Barnard, 2002). Relevant to the world of ICU, detractors to the proliferation of technology in intensive care point to life-saving devices as substantive evidence of technological ‘can-do’ overtaking decisions that ought to be constituted in the sphere of human moral values. Thus, those who advocate for a ‘dignified death’ submit that, “…technologies signify the far-reaching medicalisation of the dying process” (Timmermans and Berg, 2003, p.100). The imposition of technologies and techniques generate a mind set in ICU practice which, according to Timmermans and Berg, denies the patient autonomy over their last moments by extending their death through the machines.

## Social essentialism

The social essentialist perspective on technology could be said to lie at the opposite end of the spectrum to determinism, although it also problematises socio-technical interactions (Feenberg, 1999, 2005). This broad definition covers a series of social determining standpoints in relation to technology, including the social shaping of technology [SST] and the social construction of technology [SCOT]. Social essentialism as defined by Timmermans and Berg (2003) encompasses a standpoint whereby, “medical technologies are viewed as blank slates to be interpreted and rendered meaningful by culture” (p.101). The view from the social essentialist perspective is that technologies, their innovation and use are wholly dependent upon social arrangements and human interaction. In this way it is social arrangements that determine the outcome of technology, rather than the (supposed socially neutral) fields of technology and science (MacKenzie & Wajcman, 1999). As an indicator of the social shaping of the technological world it has been suggested that particular forms of social essentialism falter due to the reductive nature of technological explanation given over solely to social causes. Therefore, social essentialism shares similar problems to that of technological determinism in its narrow explanation of the emergence of technological artefacts. As Timmermans and Berg (2003) indicate, those who favour social essentialists in medical technology take machines as the material that mediate the world-making interactions of nurses, doctors and patients, “technologies function as sociological catalysts: they are tools that generate interactions or social meanings but do not act, affect, or evolve in themselves” ( p.101).

At its extreme, social essentialism/social shaping of technology implies that the uses, formation, invention and innovation of new technology rely for survival on their ability to be fit for purpose in social relations. However, Williams and Edge (1996) insist that in order to avoid essentialism, scholarship must engage with the complexity of technological artefacts and their relationality to a host of spheres of life: In

*“In seeking to grasp the complexity of the socio-economic processes involved in technological innovation, SST has been forced to go beyond simplistic forms of social determinism which, like technological determinism, see technology as reflecting a single rationality for example an economic imperative, or the political imperative of ruling elites.”* (p.866)

Though I would agree with William and Edge on the multi-faceted understanding needed to place technological innovation I would also add a critical point that the economic and political spheres are in essence also social forms of life.

This all suggests, following Bloor’s (1991) writing on scientific knowledge, that when theorising technological development there is a need to appeal to a ‘generalised symmetry’ between technology and human interests in their political, economic and social forms. For technology to be ‘successful’ it has to ‘work’ across multiple social worlds as well as in the realms of science and technology innovation. That is to say that the innovation/device may succeed as ‘technology’ (as assemblies of semi-conductors, circuit boards, pumps and levers and the like) whilst as a social object it may never be received. The point of socio-technical symmetry is expressed by Andrew Webster (2002) when he states:

*“[T]echnologies are only really successful when they make sense within the existing social relations within which they are to function, suggesting the crucial role played by the translation and even reinvention of technologies into everyday contexts of use.”* (p.444)

If technology is to ‘work’ it must own, or be in imputed with, social dimensions; so what counts as a useful device has as much to do with its malleability as a symbolic object in the constitution of social relations. The importance of the symbolic content of devices is made apparent in work by Timmons, Crosbie and Harrison (2010) whose examination of the automated external defibrillator (AED) and its use in public spaces demonstrates the semiotic/symbolic dimension when such devices are used to enact ‘resuscitation’ even though first-aiders recognise the victim to be already dead. In descriptions provided by aiders the performative nature of their actions with the AED symbolised that recovery was viable in order to displace the announcement of death to a more appropriate space e.g. hospital. Following Hutchby (2001) such use of the AED demonstrates the device’s social affordances beyond its technological affordances of heart defibrillation. In the research by Timmons et al., they argue that the social imperative to displace death in public spaces is a response to a shared death taboo. Thus the performative action of ‘resuscitation’ using the AED technology was a response to this taboo and a clear example of the shaping of technology to social and cultural ends.

Among the writings in the social construction of technology (SCOT) Pinch and Bijker’s example of the ascendancy of user groups in the development and changing features of the ‘ordinary’ bicycle is a classic example. Generally, in this approach the shape and use of technology becomes a disputed object contested by, “ relevant social groups who play a role in the development of a technological artefact…[T]ypical groups might include engineers, advertisers, consumers and so on” (Pinch & Bijker, 1984, p.113). Technological artefacts in the idiom of SCOT research are open to social inscription, where the use and control of any device is mediated in the interaction of social actors. Of course, whoever invests in the technology does so in relation to other social investments.

The nursing and technology literature is suffused with the understanding that technological adoption and adaptation comes as a contingent aspect of other social, economic and political interests (Poland et al., 2005). Questions about the ‘ownership’ of health technology and about its use in practice are hotly debated, contested both in policy and in practice among medical and nursing bodies (Elston, 1997). Higher levels of professional power and status may be inferred by nurses, doctors and allied professionals (as the relevant social groups) as they claim and employ technology as an aspect of their particular professional role (Crocker & Timmons, 2009; Barnard, 2007; Webster, 2002, 2007). Indeed, Barnard (2007) has argued that the standing of science and technology has benefited intensive nursing as it manages the translation of technology and technological application into ICU care. Through employing sophisticated technologies in ICU nurses have set about converting the meanings surrounding ICU patient care into practical science in action (Dean, 1998). In a discussion of the issue of science in nursing, as opposed to nursing science, Dean (1998) defines the practical challenges in medical technology environments, which make scientific knowledge suitable for ICU nursing in particular:

*Technology is the application of scientific principles… it requires nurses to have an increased awareness of the science involved, for example, a knowledge of electrophysiology for correct interpretation of data shown on an ECG monitor, or an increased awareness of the science involved if complications are to be averted due to equipment failure or misuse, so in this way some may well say that it has increased the science in nursing.* (p.205)

In social essentialist terms, the suggestion is that nurses are using the technology symbolically, establishing a ‘science’ of nursing as a form of professional activity. Knowledge of how the machines work can subsequently be used in mediating status interactions with medical staff.

However sophisticated the standpoint of social essentialism claims to be in relation to the determinist position, the criticism levelled at essentialism is it says nothing substantive about the technology beyond its manipulation by social groups (Timmermans and Berg, 2003). What is missing from analysis is the way that medical technology for example, becomes crucially involved with the care of patients rather than passive instruments and tools that facilitate the practice of nurses and doctors.

## Technology-in-practice

The third position discussed by Timmermans and Berg attempts to supersede the previous two standpoints of determinism and essentialism. If determinism gives too much power to technology in determining social arrangements, and social essentialism reduces the importance of technological objects in the construction of the world; then theories that adopt a ‘technology-in-practice’ perspective resist differentiating between ‘social’ and ‘technological’ achievements, preferring instead to examine the interplay of socio-technical systems (Latour, 2005).

Timmermans and Berg argue that theories of technology-in-practice like ANT place technology firmly in the immediate social world, where technology along with social context, relations and identities are co-producing (Law, 2008). That is to say, social relations and identities are produced through practices with technological objects while at the same time technology and the meaning attached to it are constitutive of social relations. ANT, to some extent, both encapsulates the issues based in the classic theories presented by Timmermans and Berg (2003), but also offers new insights into the real world dynamics of humans and technology in action.

ANT endeavours to sidestep the ontological minefield of agency vs. structure and nature vs. social, by insisting that the ‘social’ should be viewed as networks of associated things we might call ‘human’ and ‘material’ (or natural) objects. By bringing together and levelling out these oppositions, ANT suggests that perhaps these divisions, and everything that goes into making them up, share the same ontology. There is in ANT an adherence to the idea of equivalence, not only between agency and structure, but also the idea of a ‘generalised symmetry’ between the social and technical worlds: between humans and material objects (Callon, 1986a). By extending the implications of technology-in-practice all things in networks associated with the ICU (ventilation machines, nurses, beds, patient records etc.) must be analysed in the same terms. What if, asks ANT, the divide between big things such as hospitals and small things like face-to-face interaction or nurses’ monitoring were looked upon as the effects of networks of material and human relationality. It is not that ANT eschews the idea of binary divisions; it is just that these outward appearances are the result of network effects. As Law (1999) argues:

*“[I]t is not, in this semiotic world, that there are no divisions it is rather that divisions or distinctions are understood as effects or outcomes. They are not given in the order of things”.* (p.3)

In their survey of 25 years of medical technology theory Timmermans and Berg claim that a technology-in-practice approach to medical devices and social relations offers the way forward. With this in mind I shall follow the action of ICU nurses in proximity to high technology and describe the patterns that emerge through their performative interaction. Following Timmermans and Berg’s (2003) recommendations I aim to use ANT as a theoretical lens by which to explore and illuminate my interview data, revealing the ever-changing flows and dynamics of nurses’ interaction with technology. In the next section I will elaborate on some key concepts within ANT to highlight its technology-in-practice credentials.

## 

## Actor-Networks as a theory of technology-in-practice

Bruno Latour and Michel Callon (1981) along with John Law (1986) as early exponent of ANT, insists that ANT was never meant to be a theory. Law sees the approach as a set of tools to be adopted to aid the telling of stories of humans and things. The application of ANT according to Law lies more in describing empirical case studies, it is a methodology, a set of tactical lenses with which to mediate the complexity of human-material relationality. In the following missive Law (2008) imputes the real-world purpose of actor-networks:

*“[T]he actor network approach is not a theory. Theories usually try to explain why something happens, but actor network theory is descriptive rather than foundational in explanatory terms, which means that it is a disappointment for those seeking strong accounts. Instead, it tells stories about “how” relations assemble or don’t. As a form, one of several, of material semiotics, it is better understood as a toolkit for telling interesting stories... More profoundly, it is a sensibility to the messy practices of relationality and materiality of the world”* (p.7)*.*

ANT explores the inter-relationship of technology and humans at the actual sites of interaction. At these sites ANT holds back from concluding apriori the ontological primacy of human or technology, preferring to wait to be illuminated by the performative nature of human-machine interaction. ANT, broadly described, is a practice theory approach to technological change and development (Greenhalgh & Stones, 2010). It seeks to explain how socio-technical relationships develop and change by recourse to interactions that include individuals, institutions and the technologies themselves.

ANT insists that actant entities arises out of the effects of performative action, “entities achieve their form as a consequence of the relations in which they are located” (Law, 1999, p.4). In this perspective there is the potential for uncertainty and contingency, in that the ‘order of things’ is not the structured input which pre-figures and shapes the nature of human/technology interaction, but crucially the outcome of the relations between humans and technological artefacts. Thus, the potential openness and contingent nature of the situation allows for other forms of action and meaning to arise.

In later developments in ANT, as Law mentions above, the semiotic element of material interaction became a dominant component of analysis. It had been previously touched upon, in early ANT studies through notions of representation of *particulars*; particulars being the individual elements of networks, which later came to be called actants (Callon & Law, 1982). However, later ANT studies would bring the semiotic relationality to the fore through the symbolic ordering of actants in networks. Associations of things could be viewed as the co-production of textual inscriptions (Latour, 2005). The up-shot was that the act of reading and ordering texts became profoundly more contingent (Law, 1999, 2009), with the possibility of alternative readings have the potential to destabilise efforts towards network constancy.

**Enrolment and Translation**

The job in hand for network builders is to enrol actants (human and non-human) into network alliances through what Callon and Latour (1981) call the ‘translation’ of actant entities. Actants for ANT theorists are all speculative entities, both human and non-human that play a part in the building of network alliances. In order to accomplish the ordering of the actant onto networks these builders need to ensure that the particular interests of individual actants are manoeuvred and reframed in such a way as to tie into the concerns and goals of the network (Callon, 1986b). The work of network builders, if successful, ensures that obligatory points of passage (OPP) into the network are formed.

Ensuring translation, or reconfiguration, of all actants is important for the network if it is to remain durable in its effects. Network engineers have strategies which ensure durability over time (Callon & Latour, 1992). However, keeping networks together is a struggle; they are largely fragile entities that rely heavily on their continued enactment or performance. These enactments from network-actors both bring the network into existence and reproduce the effects. As Law (2009) indicates, “they hold themselves together but they do so precariously. All it takes is for one translation to fail and the whole web of reality unravels” (p.145).

**Black-boxing and networks as knowledge systems**

What comprises the network of actants that health professionals so deftly co-opt for effecting socio-technical 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, engineers (all of whom will be immersed in other networks of their own). The important thing is if a network is to remain stable these components need to be black boxed, that is contained and secured as durable, and thus useful, objects/actants in order for them to operate to any effect. For example, a medical protocol could be described as a black box in that it may incorporate a number of elements such as medical expertise, planning and hospital governance. These have all been stabilised at other times within organisational systems and have probably involved numerous actors and objects in the process. As a protocol, all these disparate elements have now been coalesced and stabilised as a black box which establishes a correct diagnostic procedure. This is how network influence operates: heterogeneous engineers, or network builders, gain local influence from drawing the forces of black-boxed technology, which are transmuted through the network.

In a mundane sense, all actants carry on in their own sphere of influence. The nurse as ‘patient advocate’ and ‘technology expert’ emerges likewise in her/his own micro sphere of interaction. In this space the accumulated forces within the network, made up of so many black boxes, are used to influence the socio-technical interactions. Influence taken from the network also operates as a form of symbolic power; I mean by this, doctors and others recognise and relate to nurses as technology experts in the semiotic circuit of meaning that makes up ICU world. This is, as Law indicates, material semiotics or relational materiality at play, whereby the shared understanding becomes the source of meaningful interaction (Law, 2009). Nurses appropriate this power interaction enabling them to further shape the meanings associated with their activities.

This brings into focus the work of ‘mediators’ and ‘intermediaries’ within networks. The function of the intermediary in a network is to operate as a fixed and stable black box. As a component in the assembly of elements intermediaries neither add to nor diminish the effects of the socio-technical network. This is to say, in the case of a technological artefact, the device operates purely within the remit of its technological affordances as directed by the network of designers and manufacturers of the technology (Hutchby, 2001). Latour (2005) describes the opposite of an intermediary as a ‘mediator’. The implication of this binary set suggests that mediators in fact are crucial to network change. According to Latour (2005):

*“An intermediary…transports meaning or force without transformation...mediators transform, translate, distort and modify the meaning or the elements they are supposed to carry.”* (p.39)

Here I would like to suggest that adopting an ANT approach to the empirical and analytical matters of ICU nursing allows the setting aside of the classic models of technology and social interaction without losing the core implication of each standpoint. Whilst it should be noted that each one of the standpoints constitutes a particular modality of technology and social relationality that in any observable instance could be apprehended empirically it would fail the complexity of interaction, especially when considering the temporality of action, to stick to one mode of explanation. ANT as a technology-in-practice approach can, at the same time, subsume the classic standpoints of determinism and essentialism by insisting that perspectives of technological determinism and social essentialism are an outcome effect of particular network associations.

## Technology and nursing research

Having selectively explored some of the classical perspectives on technological analysis and introduced Actor-network theory as a technology-in-practice model I now want to survey research from the field of nursing which has embodied the arguments from the Science, technology and Society literature. Much of the wider theory of technology that has entered nursing scholarship has been reframed to include concerns particular to nursing, specifically around the anti-human/cure-centric (as opposed to care) perspectives held by scholars who argue against the imposition of technology in medical practice.

Research in the field of nursing related to technology indicates that on face value technological cure and nursing care lie at opposite ends of a spectrum of nursing practice (Barnard & Sandelowski, 2001). Technology is seen as both mechanistic in its materiality and rationalistic in its ideological form. It is inattentive to ideas of expressive and empathetic care (Watson, 1988) whereas nursing represents a defined moral approach to care (Heskins 1997; Barnard 2002). To emphasise the dichotomy between technology as cure and nursing as a theory of care Gadow (1989) talks about the imperative of nurses advocating for patients which is made problematic by the disembodiment and fragmentation caused by the weight of technological scrutiny. So on one hand we have the perspective of nursing care as a humanistic endeavour specifically aimed at understanding and treating the whole patient (not just their condition). In this particular formation the relationship of carer (nurse) to patient is subjective - containing a degree of emotional empathy on the part of nurses. On the other hand in high-technology environments, such as ICUs, care is replaced by an emphasis on cure (Watson, 1988). In this context attention is directed to the technical monitoring of specific conditions and not to the patient as a whole being. Sandelowski (2000) states that in the power struggle between care and cure the technological ascendancy in nursing has left nurses struggling to define the meaning of the care ethos in their practice:

*“We nurses (and others) have variously charged medical technology with the dehumanization, depersonalization, and objectification of patients and of nursing care: that is, with depriving patients of their individuality, subjectivity, and dignity as human beings, with creating the alienation between self and body, and with separating nurses from their mission to care.”* (p.367)

In summary, much of the literature warns that technology has the propensity, when introduced to nursing care, to direct nurses’ attention to the device resulting in the supposed objectification of patients (Schaufeli et al., 1995). With reference to the determinist model, technology is invested with deterministic qualities that shape nurses’ practice. Both Sandelowski and Barnard, prominent writers on nursing and technology, acknowledge the potential for technology to side-track nurses’ best intentions towards the device (Ozbolt, 1996). In the same way Barnard (2000) points out nurses are required to reflect upon their involvement with the techno-environment to safeguard their holistic care intentions. Nurses, he concludes:

*“Cannot use technology without also, to some extent, being influenced by its use...Nurses expressed disquiet about their experience of alteration to free will. In particular, they believed that their ability to display many of the caring behaviours associated commonly with nursing, such as placing the person as the central focus of care, were being challenge.”* (p.1142)

In contrast to this, epistemic split between holistic care and fragmented techno-monitoring, is the perspective that far from reifying and objectifying the patient/nurse relationship, technologies, in their perfunctory purpose of carrying out mundane tasks, actually enable nurses to focus on the delivery of holistic care (Alasad, 2002; Heskins, 1997). In this account technology enhances, not detracts from, the moral care role of nurses (Cronqvist et al., 2004; Cooper, 1993). For many academics researching nursing practice technology is often taken for granted and seldom given the theoretical attention required for a more subtle reading. Technology is background to the foregrounding of nursing care and as such is neutralised as a tool in practice (Hanlon & Carlisle, 2009; Hoerst & Fairman, 2000; Barnard, 1997). Technology neither determines nurses’ actions; nor is it inferred that nurses shape the application of the technology through their practice (Barnard, 2007). It is purely an instrumental relation, in that technology offers rational solutions from a neutral place outside of the social manifold (Feenberg, 1999; MacKenzie & Wajcman, 1999). Of course, as Feenberg indicates, the neutral standpoint is in itself ideological in reality. Where technology is ignored because of its prefigured neutrality, or indeed employed in discursive and material practices for its enshrined properties of rationality, it is always already inculcated in a socially constructed political perspective (Feenberg, 1999). This implies that in the context of real nursing practice the interplay of technology and care is more complex and nuanced than theories which settle for dualistic interpretations might indicate.

## Expanding the concept and role of technology in nursing

We therefore need to extend the concept of technology to encompass not only the material objects that nurses use (monitors, diffusers etc.) but to include along with these ‘hard technologies’ nurses techniques, skills, knowledge and systems of practice as forms of ‘soft technology’ (May & Ellis, 2001). Theorising nurse practice itself as a form of technology thus allows the examination of ‘care’ as an activity not solely associated with humans. If we take nursing practice as an evocation of technological practice this allows the inclusion of technology as an enhancement to profoundly sensitive forms of care (such as that surrounding death) rather than as an obstacle detrimental to ‘humane’ care. Thus, Latour (1990) suggests that technology, beyond its functionality, is also invested with symbolic meaning, and that these meanings can be invested in interactions between nurses and patients. Technology may thus be invested with moral action just as humans may be deemed to be able to act morally. For example, the heart monitor has built in alarms alerting nurses at crucial points to take moral and ethical actions, such as to resuscitate. This effort by non-human technology to compel humans towards moral forms of action Latour (1992) describes as *prescription* and defines it as the “behaviour imposed back on to the human by non-human delegates... [it is] …the moral and ethical dimensions of mechanisms” (p.225). Adopting an analytical position that closes the spectrum between nursing as the focus of moral care and technology as a reification of moral care, and which moves towards a truer picture of nursing practice (Barnard, 2007; Jones & Alexander, 1993).

Arguments over the role and constructive practices of nursing have a profound impact on the way nurses’ construct their professional identities. In the next section I will examine the literature on nursing as a profession. As an overview it could be suggested that in relation to a technology-in-practice model much of the literature on nursing professionalisation comes from what I would call an identity-in-practice model: nursing identities negotiated through practice and ordering in relation to the medical field. I argue towards the end of the chapter that although an identity in practice approach can be commended for its dynamic orientation to identity construction; it nevertheless misses the importance of technological interaction in formation of nurses’ professional identity.

## Nursing professionalisation

In this section I will look at material that concentrates on the professionalisation of nursing, with a specific focus upon nurses’ efforts towards professional practice in relation to medical professionals. I will highlight research literature from the sociology of nursing that discusses the historic tensions concerning power relations between these two professions. I will then present material that suggests that nurses have in some way found a way around these tensions by employing covert and overt forms of communication that impact upon the contextual battle for decision-making between the two professions. I will then present the work of Carmel (2003, 2006a, 2006b, 2013) on ICU nursing, which although coming from a different theoretical perspective on the importance of technology to the social arrangements in the ICU is of direct relevance to my research. The review will reflect that, as other authors have indicated, the increasing sophistication and complexity of medical technology in areas of nursing has brought about a shift in the professional status of nurses (Bull & FitzGerald, 2006; Barnard, 2002; Saba, 2001; Barnard & Gerber, 1999) co-determining both the profession of ICU nursing and nurses’ relationship to the doctors.

In the sociology of nursing literature debates surrounding the status and professional position of nurses, in relation to medical practitioners, have predominantly focused on explicating differences between the two professions. These differences have largely surrounded the historic subordination of nursing expertise to the requirements of medical professionals, acknowledging without challenge the view that doctors held a monopoly of medical knowledge and expertise. May and Fleming’s (1997) work in the sociology of nursing in the UK indicates that the forces of socio-legal structures, particularly the legislated attribution of expert knowledge to medical professionals, has established localised institutional power distributions. This, they suggest, is in part due to aspirations for professional control and management of health institutions dominated by medical professionals; backed up through state enshrined policy demarcating the boundaries and responsibilities of both medical and nursing practices through divergent education, training and legal charter. This divergence has historically favoured medical knowledge above nursing knowledge in the control of health practice (Davies, 1995). In recent decades, however, nursing professionalism has emerged to contest medically dominated areas of practices (Walby et al., 1994). According to Walby et al., this has been due to the shift in emphasis in health provision away from the dominance of a scientific outlook on health towards a more socially contingent notion of health and illness experience. The growth in nursing professionalisation has helped to shape this care paradigm.

One outcome has been a differentiation of the work of doctors and nurses, one concerned with diagnoses and treatment regimens and the other focused upon the care of patient throughout their treatment. In this division of labour the notion is that the professions have developed a complementarity towards the other, each having its own tasks and roles. In this context specialist areas of nursing expertise and degree accreditation, among other things, have helped nursing raise its game with regard to its hitherto subordination to medicine (Wynd, 2003). As May and Fleming suggest, the rise of nursing professionalism has in part chosen not to compete against medicine over fields of expertise but to construct a space of ‘difference’ from medicine. This difference is expressed in nursing theory or models that understand and constructs the patient and their illness as a medico-psychosocial phenomenon. The suggestion is that nursing outlooks come from a holistic approach to patients’ illness experience (Carmel, 2006b). In this discursive construction of the patient experience nursing informs itself of its own practice activities and professional identity. The authors’ place an interesting distinction/tension between what nurses ought to do (theories of nursing process) and what they really do when nurses practice the ideals of holistic care. It is suggested by the latter that through micro care interactions with patients that contingent narratives emerge which help differentiate nursing from medicine. Theses narratives, as May and Fleming (1997) state:

*“reflect the creative impulse that must lie at the intellectual core of any occupational group. While medicine is able to focus on scientific understanding and technical advances as the site on which its imaginative impetus is exercised, nurses represent themselves as being in a different business altogether. They care about — and get attached to the patient— while doctors stay detached and seek a cure. In other words, the professional imagination provides a point of departure for the construction of a professional identity, its projection into interactions and relationships.”* (p.1097)

Nevertheless, May and Fleming point out that however nurses feel about their professional autonomy and domain of expertise there are macro institutional constraints which necessarily confine nursing to a subordinate role in clinical practice. Whether the tensions between the macro and micro imperatives of nursing practice exist or not they inevitably play out in the on-going empirical practice of nurses. However much the historic professional relations between nurses and doctors are sustained the emergence of a critique of this somewhat static relational model within nursing academia insists that research ought to examine actual in-situ interaction. Illuminating the contingent and contested areas of professional power; the negotiation of professional boundaries (Allen, 1997) and constructive inter-professional working (Pullon, 2008; Chaboyer & Patterson, 2001) can help researchers gain a greater understanding of how nurses and doctors interact (Stein et al., 1990). For although formal structures prevail (codifying and instituting practice boundaries) at the micro level caring for the ‘whole’ (social and biomedical) patient requires new ways of interacting among nurses and doctors (Allen, 1997; Svensson, 1996) which create contested points of decision-making around types of care interventions.

Exploring the supposed subordinate role of nursing to medical judgment Porter’s (1991) investigation outlines the use of four discursive strategies nurses use to level out decision-making differences between nurses and doctors. These include overt/ covert and informal/ formal decisions based communication. The point made by Porter is that these strategies are used at chosen points in interactions and attest to the on-going negotiation surrounding patient-doctor-nurses interactions. Indeed, as Porter indicates (1991), contrary to “unproblematic subordination” (p.734), ward-based nurses exercised a great deal of decision-making within the medical domain through informal and covert communication strategies played out with doctors. Of course, these strategies used by nurses to participate in decision-making activity may not be sanctioned by formal professional protocol. Nevertheless, as Allen (1997) points out, they mark the ‘negotiated order’ between medical staff and nurses in order to manage professional boundaries and the complexity of real world patient care (Pullon, 2008; Tjora, 2000).

Whilst the ‘negotiated order’ goes on differences in profession status continue to mark formal divisions between nurses and doctors. The routine tasks that separate both professions at the same time confer status on the medical profession, such as doctors’ control over drug prescribing and management of treatment. In many respects the division between the two professions acts in hierarchical and hegemonic ways. Hierarchical because it assembles status and power the further up the organisational ladder the individual doctor is situated. It is hegemonic because consultants’ wish for authority is assured through held expectations over the rightfulness of their status. It is reproduced through active consent from junior staff and the wider organisational legitimacy of the hospital organisation; where senior medical practitioners “seek to mobilise and reproduce the active consent of others in organisations” (Currie & Brown, 2003, p.6). Yet as authors like Laclau and Mouffe (2001) show hegemony is never total and, as Currie and Brown demonstrate in their research on hospital organisation, it can be contested at the lower levels of the organisation. Thus, for instance, the status afforded to medical staff is held loosely by junior doctors in relation to specialist senior nurses where their greater experience and knowledge may blur the boundary of formalised professional activities (Carmel, 2006a; Allen, 1997).

## The two professions and the boundaries of ICU

In the context of ICU nursing Carmel (2006a, 2006b) investigates the professional boundaries between nursing and medicine. The ICU environment is accorded a particular status in the ‘subordination’/ ‘competitive’ debate between nursing and medicine. To paraphrase the novelist L.P. Hartley, "The ICU is a foreign country: they do things differently there", and what they do, according to Carmel, is work on informally blurring the boundaries between medical and nursing practices, routines and responsibility. The novelty of Carmel’s analysis is to explain sociologically the reasons for the idiosyncratic activities of the ICU. In his ethnography he noticed that differences in professional activities were obscured in order to enhance the ethos of teamwork between staff in the ICU. By enhancing collective commitment to the team and care activities this informal strategy reinforces the boundary between ICU and other areas of the hospital which are likely to put pressure on the resources available to the ICU. As Carmel (2006a) states, “an occupational division of labour is rhetorically and practically obscured, while an organisational division is rhetorically and practically reinforced” (p.155). Rather than perceiving competition or indeed covert forms of resistance to medical authority on the part of nurses, the research evidences high levels of incorporation between the two professions. This integration works along two separate boundary fields for a related purpose. By practically obscuring the formal nurse-doctor profession boundary establishes a “joint ICU ‘project’” (Carmel, 2006a, p.155), directing the efforts of staff toward enforcing the boundary between the ICU and other medically allied areas of the hospital.

This alliance within the ICU, according to Carmel, comes about through the situated nature of working in the ICU. In the first instance, staff generally put in long shift hours in intensive care. The other component of this team knitted-ness is the environment of the ICU. Compared to other areas of the hospital, it is, by its nature, isolated within the hospital; its physical boundaries formally protected from intrusion from unwanted agents (biological and social) that could seriously undermine the wellbeing of patients (Carmel, 2006b). Each of these components serves to strengthen internal ties whilst emphasising external pressures.

According to Carmel’s study, the close knitted-ness of the ICU team requires a certain amount of acquiescence on the part of both doctor/consultants and nurses. For example, informally consultants accept and indeed encourage the input in decision-making by senior nursing staff. This is seen as a pay-off, amongst other things, for the limited time consultants spend with each patient. Moreover, consultants might enrol the expertise of senior nurses as evidence for their own decision-making when confronted by differences in medical opinion. On the other hand, nurses can be interrupted in their care practice by consultants’ difference of opinion over medical protocols. Carmel shows that in these circumstances nurses temper their judgement over medical staff, allowing for differences whilst buying into the importance of professional judgement. Acceptance and forbearance of these varying opinions, and tacitly working round them, is one way that nurses show respect for the seniority of doctors. Similarly, consultants take the skills and knowledge of nurses seriously with an ethos of give-and-take benefiting all collaborating work colleagues in the ICU. Acknowledging these differences between consultants and senior nurses, Carmel highlights the subtle on-going interactions that constitute the blurring of professional boundaries in his analysis. Interactions that practicably get the job of ICU care done.

At another boundary level, Carmel examines how teamwork and the ICU project buffers pressure from external hospital areas allied to the ICU, such as emergency and surgery departments. These areas are interconnected with the ICU. However, the author discloses how senior staff in the ICU mediate boundary interactions, usually entailing patient transfers- in order to reinforce the status of the ICU. As a result, upholding the remit of the ICU domain acts to differentiate intensive care from other areas of the hospital in terms of the quality of care it delivers. Indeed, both internally and externally the ICU accomplishes a notion of superiority over other hospital wards. As an outcome, ICU nurses are given and give themselves higher status in comparison with general nurses. As Carmel states (2006a), “a rhetorical contrast is drawn between the nursing ‘expertise’ within the ICU and the “ ‘chaos’ outside it” (p.170).

Carmel’s study extends the research field and goes some way towards shifting the macro debate in favour of understanding the content of both professions, not by taking for granted the division of labour but by exploring their real world relations. He helpfully develops the micro interactions, at least in the arena of ICU, and in doing so suggests that the everyday activities of the two professions remains an web of negotiations all towards a collaborative environment that sustains the ICU project. In particular, in its exploration of the in-situ interactions, Carmel’s insightful paper theorises the ICU project within the accomplishments of boundary work by staff, both in the porous boundary of internal labour divisions and in the horizontal boundary of organisational divisions between ICU and external players.

Carmel’s study recognises the teamwork that holds the negotiated order within the ICU - with the blurring of roles and tasks between medical staff and nurses (Carmel, 2006b) as an essential strategy to preserve the ICU project. The research also discloses the reinforcement of environmental boundaries between the ICU and other sites in the hospital, again as boundary strategy in order to protect medical specialism. However, Carmel neglects to focus on the importance of technology in the mediation of nursing and medical staff within the ICU and across the ICU boundary. He mentions in passing the situatedness of technology and its importance to ICU care, but makes no analytical advances in how the materiality of technical objects within the ICU play an important part in mediating the nurse-doctor interaction. For instance, he talks about consultants relying of the expertise of nurses but does not draw out how expertise might be constructed by nurses in their constant interaction with the technology within the ICU. Technology plays a neutral role in Carmel’s ICU world, and in this normative sociological account, the ontological emphasis is upon human actors alone. By taking up this sociological position the world of objects is foreclosed from analysis. Thus, the analysis misses out the importance of the ICU environment, its technology, and its place in the interactions of nurses and doctors within and without.

Both in his PhD thesis (Carmel, 2003) and later work (Carmel, 2013) Carmel acknowledges the neutrality of technological actors in human practices as a feature of his preferred theoretical approach - ‘practice theory’. In this approach material artefacts do mediate human activity as unproblematic ordered forms, however the ontological force and instigation of any social practices lies with humans alone (Schatzki, 2001). Although those who advocate an actor-network approach would describe themselves as ‘practice theorists’, there are some practice theorists who find the agency of artefacts and the force of networks as a configuring device for human activity somewhat unwarranted in empirical research (Carmel, 2013; Schatzki, 2001). As a riposte to the implied unwarrantability of actor-network theory it might be intimated that practice theory, as espoused through Carmel’s research, refuses to engage with the full implications of the materiality of the world. The upshot is that constructed themes, such as nurse-doctor ‘incorporation’, are never entirely explained in the context of the ICU. Carmel’s studies (Carmel, 2003, 2006b, 2013) do acknowledge the expertise of ICU nursing. However, he does not show us how professional expertise is manifested in the interactional moment, nor through what actions involving technology are demonstrations of expertise accomplished.

In the findings, presented later, I will describe nurses’ interactions not only with doctors but also with the objects in the network of the ICU. By taking this journey I will show that when nursing expertise, professionalism, and identity is existentially linked to their work with technological objects these nursing attributes, such as ‘expertise’, can at times falter, strengthen and indeed shift into other forms. Thus in their engagement with technology, the nurse can present as ‘scientist’, as technician, as ‘little doctor’, as ‘Angel’ (Ferns & Chojnacka, 2005). I am interested in the way that nurses incorporate with technological and human networks in their engagement with the social arrangements in the ICU: with doctors, consultants and patients, their relatives and other technological objects. This approach to the study of medical technology in action echoes the recommendation put forward in Timmermans and Berg’s (2003) review of technology research in the medical sociology. They petition to bring current theories from science and technology studies [STS] into the world of medical technology research, arguing that these ideas, particularly actor-network theory, can help illuminate the emergent context of social interactions by acknowledging the ontological importance of technology in co-configuring the socio-technical activities of actors. As Timmermans and Berg (2003) state:

*“Technology is viewed as one actor among many in changing configurations of social and technical elements (Law and Hassard, 1999) (reference original to quote)… [I]n this approach…technologies are embedded in relations of other tools, practices, groups, professionals, and patients and it is through their location in these heterogeneous networks that treatment, or any other action, is possible in health care.”* (p.104)

My criticism over the omission of a thoroughgoing discussion of technology in the mediation of nursing identity and practice extends to all of the studies discussed above. Perhaps it is the ubiquity of technology in ICU which makes it invisible to a great deal of ICU nursing research. It becomes transparent like glass, but even the thinnest of glass refracts the object that is viewed through it. So it is with nursing in the ICU, its activities and its interactions must be analysed in relation to the technological objects that make it possible in the first place. Indeed as Barnard and Gerber (1999) indicate the accent on professionalism in modern nursing in many respects hangs on the uptake of technological advances in medicine. For technological involvement in nursing practice is persuasive in articulating professional status, as Barnard and Gerber (1999) state in their analysis of nurses’ experience with technology:

*“The outcome of the experience is understood to be increasing inclusion in decision-making, autonomous practice, professional consultancy and collegiality. Technology is experienced to be a phenomenon capable of elevating nurses from their role of assistant to the doctor.”* (p.161)

Decision-making, professional consultancy and collegiality are all components of nurse-doctor relations that run through Carmel’s study which, as Barnard and Gerber insightfully acknowledge, are mediated largely by the contextual features of technology in medical environments. Unfortunately in Carmel’s study we encounter a technological blind spot in the analysis. We are denied insight into the extent that the technological environment mediates social interactions in the ICU; how relations of humans and objects interplay to establish the negotiated order.

In his second paper on the ICU Carmel (2006b) extends his analysis of the incorporated work of doctors and nurses. Here he insists that academic nursing theories that articulate the holistic view of, “nursing towards the patient as ‘relational subject’ ” (p.2086) and the differentiation of nursing in relation to medicine both contradict the actual on-going practice of nurses, particularly in the ICU. On the latter point, ICU nursing in practice does not necessarily eschew the objectifying nature of medical science. In many respects the nature of ICU demands that they appropriate medical knowledge and skills in order to service the sometimes bio-physiological complexity of the patient’s illness condition. Similarly, Carmel contends that the holistic theory can perhaps only succeed when the patient can be related to as a social entity, whereas when nurses are involved for much of their practice with sedated patients the possibility of affording a subjective care is impossible. Instead Carmel (2006b) suggests that rather than the nurse-patient dyad ICU nurses should look towards fostering a, “nurse-patient’s relative” relationship (p.2080). Here the holist approach is enacted through ensuring the patient’s social context is maintained.

Carmel’s argument that standard nursing theory does not capture fully the boundary of ICU nursing is persuasive. However, Carmel’s mode of analysis of these fundamental socio-technical relations may be contested. This study, like the ones previously discussed, again neglects to involve in any depth the socio-technical context of nurses’ interactions with other medical personnel, with patients or their relatives. Carmel is right to suggest that at any given moment ICU staff might portray themselves as the acme of holistic caring; while in another they medicalised the patient out of social existence, relying instead on their knowledge of physiological science to configure the patient in relation to their illness condition. My focus, although it touches upon many of the themes raised by Carmel, by contrast seeks to find explanation for the changing practices of ICU nurses in the complexity of shifting network arrangements involving human and non-human, technological as well as social actors.

Following ANT, I will explore nurses as creative engineers of heterogeneous elements that circulate within the ICU environment. How they do this and how they are able to configure both materials and symbols and other actors as elements in their practice will be the focus of my investigation of nurses’ understand and use of technology in the ICU.

## Nursing Identity

In Barnard and Gerber’s (1999) work on surgical nursing and technology they demonstrate that nursing professionalism can hinge on the appropriation of forms of technology as nurse technology. By taking hold of the technological means of health production nurses are able to promote a material and symbolic component of their professional identity, and indeed extend nursing expertise into areas hitherto confined as medical knowledge and activity (Barnard, 2002; Barnard & Sandelowski, 2001; Barnard & Gerber, 1999). In terms of actor-network analysis, it could be said the nurses that Barnard and Gerber describe are appropriating the technology to promote their professional standing. Building networks of new technological configurations would certainly encapsulate their enterprise as heterogeneous engineering; bringing to bear an assembly of elements and over time stabilising them to progress their interests. Through this acquisition of technological skill and knowledge they move beyond the expected boundaries of nursing work and construct new professional identities.

I am interested here in the potential for nurses, in their interactions with the technological environment, to form an array of identities. Lehoux et al. (2008) explore this point when examining the displacement of hospital dialysis technology into the community. Although the authors acknowledge the reconfiguration of identity in relation to the displacement of technology, their analysis suggests this occurred only once, as health staff move out of the clinical environment into the community. The indication is that professional identity will stabilise after a period of settlement in the new context. Critically, although I agree with Lehoux et al. on the matter of identity reconfiguration in light of radical network transition, I would suggest that identities can also be capricious in the context of stable socio-technical network interactions.

As an accompaniment to the idea of nurses’ identity construction through interaction with technology, a recent study by Ulucanlar et al., (2013) focuses on the identity given to technology in healthcare settings. These ‘technology identities’ come from the human necessity to make objects, including technology, socially meaningful. Importantly, the authors indicate that technology identities are also formed with respect to, “…the nature of the technology itself and its material properties” (Ulucanlar et al. 2013, p.103). Ulucanlar et al. suggest the construction of technology identities, mediated by the healthcare practice environment, is a clue as to how technology adoption is achieved. Although the metaphor of technology identities is described as an accomplishment akin to human identity construction, the analysis fails to reveal any reciprocal relationship where clinicians’ identities are formed in their interplay with the technology. I will note in passing that the construction of positive nursing identities might also be a deciding factor in the adoption of technology in practice.

In reviewing the literature I have shown that technology has increasingly become part of the caring world of nurses, particularly within ICU nursing. However, if we draw on the technology-in-practice model as described by Timmermans and Berg (2003) we find that very few writers and researchers on nursing and technology have fully worked through the implications of technology-in-practice in relation to their research on medical technology. It is my aim with this study to work within Timmermans and Berg’s agenda to explore ICU nurses’ practical dealings with technology; to engage and be open to the ebb and flow of network interactions that make up the world of ICU nursing.

# Chapter Three- Methodology

In this section, I will first present the methodological grounds that informed my approach to the research study. I will then go on to describe the research process including recruitment strategy, methods selection and data gathering. I will also discuss some of the issues that arise in using these methods. Following on from this I will give an overview of how the analysis was conducted, finishing with a discussion on the ethical matters involved in conducting research with nurses in a health setting.

## Epistemological assumptions

To address the questions of nurses’ situated interpretation of technology, the study will adopt an interpretive approach. The interpretive paradigm in social science research seeks to discern how individuals interpret and give meaning to the social world and indeed produce and constitute the context of their social existence. In its efforts to gather an understanding of how people constitute or construct social ‘reality’, interpretivism will focus on, among other possible phenomenon, the meaningful talk and context based practices of individuals. As Mason (2002) writes, interpretivism broadly considered is, “concerned with how the social world is interpreted, understood, experienced or constituted” (p.3) by individuals and groups who inhabit it.

Allied to this interpretivist stance, the study also considers its methodological position to be naturalistic. In contrast to positivistic research efforts to gather evidence from pre-fabricated experimental tests; where ‘laws’ of cause and effect are explained through the analysis of discreet variables is a common feature (Silverman, 2004; Hammersley & Atkinson, 2003), the data will be gathered from interviews and observations derived from researcher immersion in ‘autonomously,’ (i.e. non-experimental) ‘naturally’ occurring social practices (Mason, 2002). In contrast to positivism, the turn to naturalistic research indicates a concern for, “studying the meanings that arise in natural settings” (Silverman, 2004, p.7). In this sense context is both central and epiphenomenal to meaning making practices. On the one hand, it is epiphenomenal in that it forms the background or context for people’s interpretation of, for instance, technological artefacts in medical environments. On the other hand, the context is itself constituted by the interactional meaning making of individuals. The exigencies of this, as Mason (2002) indicates, is that the social world can present as a complex and multi-layered reality.

The interpretivist/naturalistic approach outlined above carry a number of social/philosophical assumptions that guided both the data gathering through interviews and observations, and informed the analysis. It is assumed that:

* Not only do individuals (nurses) describe the world they live and work in, but also they are involved in constructing this world through the meanings they give to the ‘world’; in this case, the ICU world.

* Thus, in their meaning making, nurses are at ‘work’ constructing, through interpretive means, the technological objects within their environment. But also, following ANT, the understanding and meaning nurses’ place on the world comes as a result of their relationality to the world of the ICU and the objects therein.
* As a point of reflexivity, the methodological stance presented here insists that whilst people are in the process of both experiencing and socially constructing the technology, simultaneously they are shaping their world through the technology.
* Importantly, both the social and technological are contingent and relational: that is to say, each factor is ‘understood’ at the moment of their interaction. Meaning, in a sense, arises as a product of the context; expressed differently it is a concern for the, “the situated rationality of action” (Murphy & Dingwall, 2007, p.2224).
* There may not be congruence between what people say and what they do. However, both activities are also invested with rationality: peoples’ actions have meaning in context, making them understood (Miller & Glassner, 2004, p131-148).

To this set of assumptions concerning the epistemological basis for nurses’ account, I wish to add that each account, although the experiential summations of individuals, also contains the material and resources of wider discursive patterns; namely the culture of the ICU. This is to say, nurses’ accounts are the unit of analysis. However, I wish to suggest that this analytical stance also allows interpretive insight into the socio-cultural milieu of the ICU department.

The following section describes the approach to informant recruitment, sampling, data gathering, data analysis, and ethical issues.

## Accessing the field of ICU nursing

The research fieldwork study took place at in a large teaching hospital in the East Midlands. In order to gain access, in the first instance, I contacted senior staff through an introductory email to senior consultant practitioners at the East Midlands Critical Care Network. The network operates to bring together practitioners, patient-stakeholders, and educationalists involved in critical care in the East Midlands. Through numerous email exchanges with senior medical staff, I was advised to contact the consultant nurse at the hospital. After an email requesting possible access to the ICU, I was invited to meet with the nurse consultant in charge of ICU services. Our initial meeting had been very positive, with regard to potential access. At the meeting, which I had prepared for, we discussed my plan for data gathering; the number of nurses I would interview and the form the observations would take; as well as the likely timetable for data gathering.

I left the meeting with a positive feeling of support from the consultant nurse. Hammersley and Atkinson (2003) write about gatekeepers and their importance to successful access. They mention that access permissions come in different forms, and it might be necessary to gather them all to ensure unhindered access.

One has to talk of access and permission in the plural. To do any research, as I found out, in the UK National Health Service, requires the researcher to seek multiple permissions both informal and formal. Furthermore, in real world research informal permission can turn to formal request and vice versa. In addition, different types of permission processes can run in parallel or consecutively. Each of these points of access requires negotiation, one moment with large bureaucracies, and in another face-to-face personal engagement with stakeholders and gatekeepers. I will briefly deal with these matters of access in turn.

The nursing consultant would become the key gatekeeper for the practical side of access; ensuring that senior staff were aware of my arrival on the unit and what I needed to achieve during my period of fieldwork; smoothing the way in terms of time and space for me to interview ICU nursing staff. Her enthusiasm for my research remained constant through my fieldwork period, ensuring that I would be extended all possible access to the ward environment. Indeed, much of the later access requests, after receiving local Research & Development (R&D) approval and national NHS ethics approval, became informal permissions given by ICU staff as part of their daily running of the ward. Nevertheless, as part of proper research conduct, I felt that I should continue to ask for permission to enter the unit whenever I visited. This I felt reflected appropriate standards of research conduct.

Returning to the first meeting with the nurse consultant, I was asked to write up a brief proposal of the research. This would be presented to clinicians at the Hospital’s critical care network meeting. After the proposal was considered, it was accepted in principle that the research could go ahead; after all formal channels of research approval had been met. What followed was six months of Integrated Research Application System (IRAS) applications along with local R&D approval. After all formal gate keeping processes had been satisfied, and ethics approval granted, I spoke with the consultant nurse, and arranged to meet again to plan my introduction to the ICU field.

We met and discussed a timetable for the fieldwork. The first phases involved timetabling five blocks of time for observations. After this period, as the observations continued, I would start the second phases of recruiting individual nurses for interview. In order to do this, as part of the IRAS process, I had devised information sheets and consent forms for both the observations and interviews. As part of my initial introduction to staff, I supplied the consultant nurse with copies of the letter of invite and information sheets for interview recruitment (see appendices A, B and C ) and asked that they be placed in the pigeonholes of all ICU nursing staff. The information sheets invited individuals for interview with appropriate information as to the purpose of the research, details of informed consent and expected participation commitments (i.e. interview time and place). I also asked consultant nurse to announce my research programme prior to my arrival on the ICU, as part of scheduled staff meetings.

It was planned that I would initially engage with the unit’s staff and environment by starting my observation work. This approach gave me the opportunity to familiarise myself with the environment of ICU nursing, (a wholly new experience for me!) and to introduce myself to the ever-changing rota of nursing staff who work on the unit, before recruiting nurses for interview. During the initial period of observations, I became familiar with some of the nurses. This gave me the opportunity to discuss my research with them, and to ask if they would be willing to be interviewed.

As it turned out, with the senior nurse’s encouragement, gathering candidates for interviews was relatively straightforward. Due in part by nurses being intrigued with the subject areas of science and technology studies and how ICU nurses’ involvement with technology might figure in the scheme of things. In addition, the ICU views itself as a research active unit. Although, most of the research conducted on the ICU comprises clinical trials, staff were familiar with research activity and their occasional involvement in it.

With regard to observation periods, I would visit when professionals deemed it appropriate. As it happened, staff were happy for me to observe their practice, though the information sheet indicated that anyone not wishing to be observed at close quarters could withdraw their permission. This approach to observing the ICU and nurses was in tune with patient confidentiality- no observations were carried out when bed screens were drawn; as well as recognition of and sensitivity to the changing circumstances of ICUs. These last two points being important considerations in research conduct. Throughout the data-gathering period, I liaised with ICU staff to ensure that all participating nurses were kept informed of the research process.

## Participant recruitment and interview strategy

Participants were recruited from staff working in ICU environments. For the purposes of balanced sampling, the research design used strategies influenced by purposive sampling strategies (Mason, 2002). This ensured that the social make-up of respondents reflected the overall balance of nurses in the ICU, which was approximately 80 members at the time of the fieldwork and interview period. The use of purposive sample also ensured that a representative mix of all potential informant was achieved (Teddlie & Yu, 2007). In all, 20 in-depth interviews were conducted as part of this research study. The interviewees comprised of six male and fourteen female members of the nursing staff, this ratio reflected the wider sex mix among all nursing staff in the OCU. In addition, I also strived to mix the age and experience of staff by interviewing junior staff and students along with senior and older ICU staff. Although the task in purposively selecting particular interviewees was to get as broad a perspective as possible on technology, the selection process had also an element of pragmatic convenience and ‘snowballing’(Teddlie & Yu, 2007). Not all staff wanted to be interviewed. However, I attempted to seek as wide a range of views from across the staff group as possible, while acknowledging the notion that my sampling did rely on the convenience of selecting staff members who were happy to be interview.

The interviews were conducted using a semi-structured interview schedule (see appendix D), the purpose of which allowed the research to explore set themes from the nursing and technology literature. At the same time, respondents could elaborate upon details they felt were important to the topic area. Employing this interview technique ensured that interviewees’ views were freely expressed without constraint from the thematic schedule.

I have already stated that the overall investigation of nurses and technology would be driven, theoretically, by insights from actor-network theory. One issue raised when taking this position, was how to *operationalise* these ideas into questions understandable to participants (Mason, 2002). It was easier, in fact, for nurses to talk about how technology determines their routines and tasks- more difficult to talk about networks and heterogeneous engineering. Similarly, nurses grasped the idea that they might shape or use the technology in ways, which were different from its intended purpose. For example, I recall one nurse talking about using glue from a different pack in order to secure a patient’s nasal gastric tube because the fixative that came with the tube was inadequate. The solution to the problem of ‘*operationalising*’ (Murphy, 2003; Mason, 2002) ANT ideas, was to let the nurses’ emic understanding be the resource for exploring network relationality. So, for example when nurses mentioned the terms term ‘chasing numbers’, or ‘looking after organs’ I would follow up these, “significant indigenous [emic] categories” (Hammersley & Atkinson, 2003, p.194) by exploring the potential for them to reveal network building strategies on the part of nurses. However, the task of ‘operationalising’ concepts in the cut and thrust of interviewing participants at times lead to dead-end questioning, breaking the flow of the conversation. In contrast, Mason (2002) suggests rather than thrusting dry and complex concepts into the interview, there is more to be gained, in terms of gathering meaningful data, by merging conceptual ideas into questions. The focus should be more on, “lived experiences than hypothetical…abstract concepts” (Mason, 2002, p.68). Participants should be empowered to explore actions familiar to their daily activity, in a meaningful way. In attempting to provide the space for nurse interviewees to do this, I was required to undertake a great deal of analytical and reflective processing while conducting the interviews.

A further point should be made on the issue of the status of the data derived from the interviews. As the argument goes, in qualitative research, material derived from interviews is only a construct managed between the interviewee and interviewer. The problem arises as to whether this evidence should be used outside the constructed conversation of interviews (Miller & Glassner, 2004; Silverman, 2004). Commentators on qualitative research suggest that the contextual limits of interview data should be acknowledged. While at the same time, this should not delimit the fact that interview participants can provide information about the ‘reality’ outside the interview context (Miller & Glassner, 2004). Indeed, if the place of the interview is kept within the overall research context, e.g. the ICU, it can become a resource to engage with accounts of reality. For example, the interviews conducted for this study, occurred in spaces familiar to nurses as part of their daily activities. One of the rooms used had a new dialysis machine present, which nurses used to refer to particular interactions with technology.

Having discussed some of the issues around interviewing as a strategy for data gathering, I will now return to the practical matters involved in interviewing nurses for this study. All interviews conducted for the study lasted approximately one hour. The majority of the interviews were conducted within the confines of the ICU; either in staff meeting rooms or offices set apart from the main unit. By arrangement, interviewees preferred to be interviewed prior to, or just after their shift. A handful of interviews were conducted on shift. On the occasions nurses were interviewed at work, the opportunity arose when senior staff felt the unit was settled enough to free staff from duty to participate in an interview.

At the interview, participating nurse were given a further hard copy of the information sheet. In line with appropriate interview technique, I further outlined the contents of the information sheet, and addressed any questions that participants had with regard to the research aims. They were informed that the interview would be digitally recorded; that the recordings would be transcribed and stored in a password-protected computer and only myself and supervisors would have access the raw interview data. After this introduction, which was reiterated with all interviewees, participants were asked to sign a consent form. At this point interviewees were given a ten-pound gift voucher as a token of appreciation for specifically taking part in the interview.

There is much debate surrounding rewarding people for research participation. On the one hand is the view that offering rewards acts as a form of coercion, particularly within disadvantaged communities. On this point, Head (2009) notes that monetary incentives, even relatively small amounts, may be too lucrative to refuse. However, in recent times, the ethical stance appears to be that research studies should reward people for their time, effort and the local knowledge they bring to illuminate the research findings.

## Observing the ICU

Along with interviewing nurses, I conducted observational studies in the intensive care unit. Observational studies under the mantel of ethnography has a distinguished place in health research, among which Goffman’s study of mental health (Goffman, 1970) and Glaser and Strauss’ (1964) study on hospital deaths are exemplars. This particular approach of observational research, throws up a number of ethical issues, which are explained below. In this study, the purpose of the observational work will be to acknowledge the actual interaction of the nurses with the technological environment of intensive care nursing. The thinking being that this supplementary data gathering method arises in the researcher’s belief that individuals’ interaction with both the environment and the objects within it takes place at an intuitive level. Moreover, at this level much can be understood from observing how nurses might make sense of technology. Indeed, for some nurses, their long-term involvement with the health technology at their disposal, can result in taken-for-granted the resources and tools they use as part of their nursing role. By observing nurses’ interaction with technology and indeed other nurses, this phase of the research helped inform the interview schedule by assisting respondent to elaborate and clarify their actions.

The observations and interviews were conducted in phases. Initially I conducted observations, and then started interviewing while carrying on with the observations. This enabled an iterative approach (Mason, 2002) where observation would inform interview content, by way of follow-up questions on the observations. This iterative approach of observing nurse/technology interaction on the unit and then later discussing the activity during interview, helped in firming up some of the themes I explore in the section on findings.

With regard to the tenets of qualitative research, adopting this iterative approach to the interviews and observations also served to provide triangulation in the data gathering, whereby one source of information is tested against another in order to assert the veracity of the phenomenon under investigation (Hammersley & Atkinson, 2003; Fetterman, 1998). This approach involves the triangulation of methods. However, there is other way to perform triangulation in research (Mason, 2002). The strategy of triangulation was used during interviews when looking at the thematic contents of nurses’ accounts in the initial interviews to verify particular phenomena in subsequent interviews. So for example, when one nurse used the term ‘chasing numbers’ to express an aspect of patient care, I was interested to follow this theme up with other interviewees to understand if this was a shared phenomenon in the culture of the ICU. Similarly, when another nurse talked about, “looking after organs” this interesting conceptualisation of the patient under technology, directed me to explore the resonance of this idea for other nurses. This approach suggests a triangulation of the data for theme building.

The use of triangulation in qualitative research, as a marker for validity and reliability is problematic. For some commentators, such as Blaikie (1991), Seale (1999) and Mason (2002), triangulation in qualitative research has adopted in part the quasi-robustness usually associated with positivist research. Tied, as this research paradigm is, to the ontology of stable empirical objects any, “triangulation used in this way assumes a single fixed reality that can be known objectively through the use of multiple methods of social research” (Seale, 1999, p.473). In qualitative research, it is implied that multiple methods, used to reveal the same phenomena, will give a more exact understanding of the entity under investigation. However, as Mason (2002) indicates, when we take on board the precepts of qualitative enquiry, we are met with the understanding that different methods are, “likely to throw light onto different social or ontological phenomena” (Mason, 2002, p.190). As a solution out of this- one I would agree with- is not to consider triangulation as a means of empirical verification, but as a way to enrich the description and understanding of the phenomena. Thus, observing ICU nurses and then asking them about their actions during interviews allowed me to explore the phenomena in a more rounded way. If this also throws up contradictions, then so be it. As Mason (2002) further indicates, taking this approach to multi-methods research might enhance validity as it shows that, “social phenomena are a little more than one-dimensional” (p.190).

The overall fieldwork was conducted over approximately four months between October 2010 and February 2011. Within that time, I spent forty hours on observation. A large majority of the observational work took place on the Adult Intensive Care Unit at the teaching hospital. Observations were carried out during morning and afternoon/evening shifts in four-hour sessions. As I describe in the ethnography section, this time period was optimal. It allowed me to target specific activities I wished to observe, without being overly bombarded by periods of extended observation. Following each observation period, I set aside an hour immediately following to expand on the notes I took while in the field. This space, out with the ICU, was an opportunity for reflection, to gather my thoughts, and make tentative connections among the various discrete phenomena I witnessed.

Programming the observation work for morning and afternoon sessions gave the opportunity to observe nursing teams across their working day. As well as the dayshift, the observations encompass afternoon-evening shifts. On reflection, both shifts offered many opportunities to observe various routine activities, including, preparing patients for transport to the MRI scan department; portable x-rays on the ward and setting up of dialysis machines. This was also a time to observe nurses interacting with patients’ relatives, of which I will talk more in the findings section.

## Ethical concerns

The data gathering methods outlined above highlight a number of ethical issues. In the first instance, interviewing nursing staff required the study to seek informed consent for the actual interview and the use of subsequent data. To mediate individual consent, all interviewees were given an information sheet outlining the nature and purpose of the study prior to interview. The information covered the responsibilities of the research to ensure that any potential risks in terms of disclosure and confidentiality were minimised. As part of the researcher’s responsibility, the conduct of interviews will minimise issues of personal and psychological harm that might ensue, (Murphy & Dingwall, 2007). This safeguard will extend to any subsequent report of findings. Interviewees were clearly informed that they could withdraw from the study at any time, and any information that they had given would be removed from the study.

On the matter of research data management, all recordings and transcripts are held on a password-protected computer. The only personnel with access to the raw data throughout the study have been the PhD student and two immediate supervisors.

The ethnographic/observation component of the research involved further issues that need addressing. Although consent was given by the nurse consultant to observe the ICU environment, consent to observe nurses going about the duties required individual’s consent. This was negotiated with each member of staff on an ongoing basis. So, it would happen that on one shift a nurse would consent to me closely observing her/him, and on another shift, the same nurse might for good reasons, decide to withdraw that consent. This of course was respected. Fortunately, this seldom happened and when it did occur, it was usually for the patient’s best interests. Similarly, the issue of visiting professionals to the unit had to be negotiated. Although the observation focus was on the nurse, to counteract issues of ‘over-observance’ a clearly defined framework of observational goals were devised and agreed between management and researcher (Murphy & Dingwall, 2007). It was explained to other professionals in proximity to the observation that the focus and limits of the observation were on the nurse’s interactions with the technology. As the period of observation went on over the weeks and months, any issues regarding potential over-observance were dealt with through informal conversations with all involved at the point of interaction.

All of the above ethical considerations were extended to the patients receiving care. However, the nurse-patient interaction brought further ethical considerations. Where I could explain and inform visiting professionals of my purpose in observing the interaction, for sedated patients this was impossible. At these moments, I relied both on my own research concerns to keep these observation periods to a minimum, and to only observe and record interaction in line with the research aims. No details were recorded with regard to the physical or biographical features of the patient. With regard to visiting relatives, when appropriate, I informed them that I was conducting observation research, but at no point was I recording details of their loved-one.

All of these ethical considerations were addressed and accepted by the NHS research ethics committee (IRAS) and the local research and development department based at the hospital, which gave the research study a favourable outcome and subsequently gave permission for the research to be carried out.

## Analysis of the data

All interviews were recorded using a digital recorder and transcribed for analysis. The actual analysis commenced shortly after the first interviews. This allowed me to reflect upon the content of the interviews and develop ideas and lines of enquiry in subsequent interviews. Similarly, the field notes were transcribed and further annotated. Here again, points of interest in the observations, were developed as the observation periods continued.

The period of in-depth analysis was conducted once all the fieldwork was finished. Procedurally, the transcripts where uploaded on to Nvivo software for more formal analysis. In the first instance transcripts were read in their entirety, and notes were made regarding possible thematic codes. At this stage, any discrepancies in the interviews were corrected. For example, if a particular section did not make sense on the page, I referred back to the original recording to verify the meanings expressed at the time of the interview. At these points, I might notice the way interviewees expressed their views, i.e. using sarcasms, humour, or indications of uncertainty. Using these vehicles of expression, I was able to clarify the possible meanings people wanted to convey.

There is much that can be achieved in following processes in order to prepare the data for analysis. However, there comes a point when the analytical imagination has to enter the scene and lend a hand. To get to the stage where I could scrutinise the data for initial codes required extensive immersion across all the components of the research. Firstly, it starts, I believe, with understanding the literature. For me this meant reading extensively in the field of ANT, as well as across the large amounts of science, technology and society literature. The point is to reach familiarity with the way other researchers using ANT have used the theoretical insights and concepts.

As I moved through the transcripts, I was not reading these texts for the first time; I was not meeting this world through these texts. Instead, they worked in a way to remind me of the ICU world I had recently left. Reading the transcripts reconnected me to the observations and interviews with real nurses and my efforts at the time of the fieldwork to piece all these discreet packets of information together to understand the whole or at least part of the whole, in order to construct a convincing story of nurses and their understanding of technology.

Returning to the first phase of the analysis, each interview transcript was coded into thematic nodes using the Nvivo software. These codes/nodes were not constructed prior to the analysis, but ‘emerged’ from carrying out the coding and guided by reflexive engagement with particular theoretical perspectives. At this stage, some ninety nodes were devised, each one containing discrete passages of interview material. After all the interviews had been coded, a period of reflection and inspection of the codes took place. Interpretation of the data is always on going. However, at this stage, after scrutinising the codes, an involved and deeper interpretation was required to condense the disparate collections of codes/nodes down into workable analytical categories. As an interpretive tool I used standard theoretical insights around ‘technological dependency’ and ‘technological shaping’. For example, in the second phase of analysis a number of first level codes (and their content of interview extracts) indicated that ‘balanced numbers’ was an indicator of patient stability. It seemed that in caring for patients, nurses depended on a steady and accurate flow of numeric information. Thus, ‘balancing numbers’ emerged as a substantive theme for nurses’ dependency on technology. This approach to the data was also carried out on codes/nodes that indicated nurses were also shaping their use of technology.

At this point in the analysis, it would have been straightforward to report that some nurses are dependent on technologies, while others shape the use of technology, thus reflecting two classic positions in the science, technology, and society literature. However, reflecting on the real world of the ICU, by looking back on thoughts I jotted down in my field notes; it was evident that matters were a little more fluid and dynamic. At one moment nurses appeared to be dependent on the medical technology to provide care, then at other points the data suggested that they were using technology in order to achieve particular social aims. I wanted in some way to capture the sense of shifting relationality between nurses and technology.

It was at this point I turned to ANT as an analytical lens with which to interrogate the data further. With the conceptual tools of ANT, I came to the interpretive position that these points in nurses’ accounts, which highlighted both dependency and social shaping of technology, were the effects or outcomes of socio-technical network configurations. For example, as I show in the findings, I interpret the claim “looking after organs” as an effect of nurses’ dependency on knowledge/information coming from the various specialist technologies developed for specific organ function. These medical devices, as information providers, become an *obligatory point passage,* in ANT terms (Callon, 1986b), influencing not only the nurse’s interaction with patients but also, in some measure, determining the discursive formation around ICU care, i.e. not looking after patients but looking after organs.

In the final phase of data analysis, I returned to the analytical themes I had constructed from the data, and explored them further using the conceptual perspectives of ANT. This helped open up the data to a more fluid interpretation. There exists in the findings indeterminacy in nurses’ actions around technology, keeping the possibilities open for change, rupture and reversal. However, I believe this approach gets nearer to reflecting the nuances inherent in nurses’ understanding and interaction with ICU technology.

There was no privileged position given to the observational interpretation of the research field. The insights gained from the field notes were equal to other meaning-making systems employed by participants. In the same way, analysis did not attempt to force agreement between observation and interviews with staff. Both data fields may at certain points converge in the interpretation of the situation and at other times diverge. This analytical commitment imposes certain constraints on the notion of triangulation of data gathering in order to strengthen a principled commitment to revealing a plurality of meanings, and experiences of nurses and their work involving health technology.

The observational data has been used, largely, to describe the setting and to highlight features of the ICU environments and the people and technological artefacts that inhabit the space, thus it owes more to the tenets of descriptive *ethnography* (Hammersley & Atkinson, 2003). Indeed, much of the groundwork that informed the content and questions in the interviews came from the observation made on the unit. It might be considered as a form of triangulation, but as Mason (Mason, 2002) has argued, it should perhaps not be taken in the ‘realist’ sense (see discussion above), but as an aid to clarify the meanings inherent in particular social phenomena, to reach a more rounded understanding and explanation of human technology interaction.

## Emerging methodological issues

While I am discussing methodological issues, I wish to point out that by undertaking the principles of ANT research, to follow the actors, there is a thread of analysis and discussion throughout the findings sections. It has remained an issue for me to adhere to positivistic precepts of thesis presentation while engaging with Actor-network theory. That is, to present the findings/data section separate from any discussion or analysis (Firestone, 1987; Eisner, 1981). In standard presentation the positivist sleight-of-hand works by casting the empirical material as objective brute-data, free from the subjective interpretation (and bias) of the researcher-observer; who at a later point in time during discussion reveals post-hoc, the objective meaning inherent in the data (Mitev, 2009).

For me, two issues arise from what Firestone describes as the ‘objectivist rhetoric’ of positivist presentation (1987, p.17). One concerns ANT and my attempt to work within this approach, the other being a general issue within qualitative/interpretive research. Firstly, adopting ANT as a methodology (see Mitev, 2009 for a discussion on ANT as both theory and methodology), requires a commitment to follow the actors. I take this to mean that any description, discussion, and analysis should be carried out at the point where participants reveal their worlds through the data. If the work of the researcher is to show the network traces, translation efforts and points of passage or present the details of heterogeneous engineering, I feel this is best achieved at the same moment as presenting the data, before they go cold, as it were. Thus, in the findings section I have already commenced the task of presenting analysis and discussion. However, I will present a formal discussion chapter after the findings, which will extend and elaborate on key ideas that emerged throughout the findings.

The second point deals with the nature of qualitative research and the world-making position of the researcher. The rhetoric of positivistic social science sets up a methodological distancing between the objective world of brute data and the analytical work of researchers (Firestone, 1987). However, this division between the object and its representation has been met with criticism from commentators who are more inclined to the position that the world(s) in which we inhabit are a constructed and reflexive accomplishment. This is true, not only to the actors who inhabit that world, but also the researchers who investigate it (Silverman, 2004; Mason, 2002; Woolgar, 1988). Thus, there is no separation between presenting data and deriving understanding from it. All research activity, suggests Woolgar (1888), is an interpretive act. Even when data is presented as stand-alone evidence of objective phenomena in the world, we are taking an interpretive stand that has to consider why particular pieces of interview data is presented and not others, and what kinds of representations are we trying to build by selecting these particular stories.

## Layout of the Findings

The first section of the findings describes the setting of the ICU and the wider hospital. Within this section, I provide a description of the environments, the layout of the ICU and consider some of the technology which nurses use in their nursing care practice. The observations also contain some reflexive features that situated me, as observer, into the world of the ICU. I consider some of the concerns and trials of undertaking an observation study in an environment, which was very alien to me prior to starting out to explore nurses’ interaction with technology in the ICU. Along the way, I highlight particular occurrences that depict the everyday activities within the ICU and attempt to throw some conceptual and theoretical light in terms of their network properties.

Following the section on the observation of the ICU, I present the findings from the interviews. In doing this, I have decided to divide the findings into three areas of interest. Firstly, I present and discuss those aspects of nursing practice around technology that suggest the dependency of nurses on technology. However, as I carry through the presentation of findings, my aim is to shift the idea of determinacy and dependency and to look upon the particular interactions highlighted as effects of network interaction. Similarly, in the next chapter I start to address nurses’ shaping of technology and again work with the data to reveal the network influences that nurses use to re-order the semiotic meanings placed on technology, particularly with regard to their interaction with medical staff. I also explore the relationality of nurses and patient’s relatives in the technological milieu surrounding patient death.

In the final section, ideas of technological determinism and essentialism are diminished, as I attempt to develop a fully ANT explanation of the progression of patients as technological bodies, to patients as social beings. The idea of a changing or mutable patient form is derived from nurses’ representations, which are in turn mediated by the techno-human network. I finally discuss the idea that two forms of vigil inform the lived-world of ICU nursing: the *care vigil* and the *technological vigil.* I suggest that both of these vigils are once more the result of a host of heterogonous elements operating in the dynamics of network interaction.

# Chapter Four- Findings

## The observation study on the ICU

In this section on the observation study of the ICU, I have chosen to write in a style that reflects the practice in ethnology work that places the observer-writer within the culture that is being studied (Van Maanen, 2011; Charmaz & Mitchell, 1996). I have taken this approach not simply to convince others of my authorial position- the “I was there, and this is how it was” stance, to garner empirical veracity. I hope there is an element of this in what I write, although the main aim is to take up a more modest approach to storytelling, which recognises the partial nature of the world that comes from one voice. Old standards of ethnographic practice might have been to remove any notion that the writer is involved in constructing the world they are also investigating through conscious obliterating of the ‘I’. On this point Crapanzano (1977) notes that, “anthropologists appear particularly disturbed by the presence of the personal pronoun in a "serious work” (p.69). Today, the ethics of observation place the writer in the midst of the phenomena/culture under investigation. As Charmaz and Mitchell (1996) point out, “we advocate developing an audible writer's voice that reflects our empirical experiences; voices ranges from the evocative to the analytic” (p.285). I attempt in the following section to move into describing the ICU, by retaining an authorial ‘I’ presence. As I move through the ICU world, I want to relate my observations in ways that move, in turn, from evocative description to analytical insight.

## The hospital environment

The intensive therapy unit is situated on C floor of a large East Midlands teaching hospital. Described as one of the largest acute trusts in England and purpose built teaching hospitals in Europe, it provides services for over 2.5 million residents in the East Midlands. The centre holds 87 wards and around 1,700 beds, with 25 surgical theatres. The main hospital was completed in 1978 and presents a somewhat stark and functional exterior to the visitor. The main building is made up of four Blocks: north, south, east and west. All four blocks intersect to create several miles of corridor space.

As one enters through the main foyer into the hospital, visitors are met with a busy main concourse that resembles the new approach to designing hospital reception areas. In this first space there is now the ubiquitous array of coffee bars and boutique shops selling gifts, flowers, and in this particular area, leisurewear. The rise of this development in ‘front of house’ hospital spaces has emerged with the increase in recent UK governments sponsorship of Private Finance Initiative [PFI] (Macnaughton et al., 2009; Gesler et al., 2004). Although the hospital is not a new build, recent refurbishment of the main foyer and reception responds to NHS initiatives to develop hospital environments, not only as places of clinical management, but also as therapeutic spaces. Along with an effort to adapt hospital spaces as environments to promote wellbeing (Kearns & Barnett, 1997), there has also been an effort to link wellbeing and consumerism in hitherto market free areas like clinical environments.

Part of the shift within hospital environmental planning has been to instigate the same consumer activities involved with everyday life. As Gesler et al. (2004) state:

*“Healthcare providers are responding to these consumerist pressures by introducing to clinics and hospitals consumption spaces similar to those of private, commercial outlets including shops”.* (p.118)

In proximity to the cultural symbols associated with health and healing, the consumerist culture creates a buffer whereby consumer identity as sovereign choice-maker is exercised before the perceived loss of autonomy is experienced by patients in the hospital setting (Gilmour, 2006; Taylor, 1979; Goffman, 1970).

These through-places in effect act as liminal spaces of transition, where the forces surrounding consumer identity are eased and prepared for transformation into patient identity. The upshot, according to commentators, is that hospital designers have shifted attention onto constructed environments that tap into those symbolic representations, which accrue around shopping activity. As Gesler et al., (2004) state:

*“This has meant that the new generation of hospitals seek to reconcile many of the traditional functions of hospitals (i.e. surgery and post-operative care) with a consumer-oriented role as accessible providers of health care, advice and treatment. These shifting goals are, however, being encouraged through a diverse range of design features, encompassing modifications to the social, symbolic and physical spaces of hospitals”.* (p.126)

However, the use of health environments as areas of consumer culture raises questions regarding the suitability of the contrasting environments and their service to medical practice. For as diverse as individuals can be, the appropriateness of these therapeutic endeavours lies in the eye of the beholder. Thus, the efficacy of consumerist environments in hospitals remains a contested idea (Gesler et al., 2004).

Returning to my own apprehension of the hospital reception, one is struck with the scale of human traffic. Of course, this is a busy hospital and one would expect the general through traffic of patients, visitors and hospital staff, but there is surprise at the amount of people participating in consumer activity around the shops and cafes. I arrive for my first fieldwork session at around 10 am and the cafes are bustling with hospital staff and visitors purchasing drinks to sit in or take away. Having all the presence of a town centre shopping mall, the shops and cafes are open fronted, blurring the distinction between being in the shop and standing out in the corridor. The main reception has the look of hotel reception about it, where corporate blazer-wearing staff greet individuals in a manner suggesting ‘hospitality is our goal’ and ‘can-do’ efficiency.

I was reminded on this occasion and on others as I passed through the hospital portal; entering the ‘hospital mall’ of observing the scene as a 19th Fin de siècle *Flaneur:* I observe, taking in the cultural scene, attempting to understand the activity that unfolds before me. I like Mike Featherstone’s (1998) description of the flaneur and the activity of flanerie. Taking his cue from Walter Benjamin’s (1999) description of the Parisian arcades, Featherstone sees the flaneur as an important documenter of city life. Of course, the hospital is not a city, but neither is the hospital a shopping precinct. There is something strange about apprehending these cultural forms as texts: a coffee shop with open front and near by a patient stands in long bed gown pushing along their portable drip stand. While ambulances arrive or depart with trolleys bearing patients, to whatever destination throughout the hospital or city beyond the entrance, two women are perusing the clothes rails in the open fashion boutique. There is something about the juxtaposed reading of consumerist and patient, and the indeterminacy of context, that un-anchor expectation of the hospital visiting experience. This arrangement of forms, so appealing to designers striving to create new therapeutic environments, sets up, as Featherstone (1998) comments, “no place spaces” (p.910).

During the period of observations, I have come through the main entrance at different times of the day: morning, afternoon, and evening. After 5pm, when the shopping stops, the usual scene of a few patients and visitors mulling around the foyer, takes over. Everything appears sedate and hushed, compared to the hustle and bustle of the nine-to-five of the hospital-shopping nexus.

Much of the efforts to change the design of hospitals, and introduce these oases of consumerism, along with strategic positioning of art objects (Macnaughton, 2007) is geared towards assisting people with wayfinding around large hospitals (Rooke et al., 2009, 2010; Easter, 2007). The hospital is an older building, designed in the early 1970’s along functional requirements; it shares none of the ethos of the new movement in hospital architectural design to enable visitors to negotiate their way through the hospital. There is an absence of features such as asymmetric spaces that act as marker points for people to remember and recall as they their negotiate journey. Beyond the main entrance, patients and visitors are met with a series of long corridors, each one non-distinct from the other.

Making one’s way to the ICU from the main entrance involves a lengthy walk following the signs through corridor spaces. After a number of visits, I learned to discern one corner turn from another as the paintwork shifts from a calming aqua green to a garish salmon pink. I recall that the time between my initial access visits to the ICU and commencing the actual fieldwork, I turned up at the wrong ward. I was quickly put right and sent on my way to find the ICU down another two barren corridors.

## Entering the ICU

The ICU is entered through a series of double doors. The first set of doors takes you from the main hospital corridor into a small space of around three meters square. Facing the doors from the corridor is another set of double doors. On the walls in this space between the ICU unit and the hospital thoroughfare, are information posters giving visiting times and infection control information. Another poster near the doors entering the ICU asks all people entering the unit to clean their hands using the antiseptic gel dispenser fixed the wall. It seems obvious as I observe the small space, that it functions to order the coming and going of human traffic, more specifically, bodies and their harmful microbe detritus. I will say more about how this area operates as a boundary between the ICU and the rest of the hospital later, when I explore way in which technological interaction orders nurses’ embodiment.

After washing my hands I am then standing at the intercom unit on the wall next to the double doors that leads on to the main unit. I read the instructions ‘please press button for attention’. Next to the intercom a further notice says ‘do not let others follow you into the unit’ – more efforts to control bodies. On pressing the button, I wait for a response and after some time a voice asks if it can help me. On the lengthy walk to the unit, I have rehearsed what I will say: “Hello, yes, this is Brian Crosbie PhD student; I’m starting observations on the unit today”. There is a moments silence then the voice says, “Hold on a minute please”. There is the sound of the intercom going dead and I wait for some time before the voice says, “Okay come through”.

I enter the environment and immediately notice the noise of the unit. There are bleeps and buzzes going off all around. I first approach the reception desk, which sits immediately opposite the main entrance I have just come through. Around the long desk, a few professionals in uniforms and scrubs stand or sit; chatting or silently surveying a computer screen. I move forward to the desk and speak to the receptionist. Again, I introduce myself and ask for the consultant nurse. Unfortunately the consultant nurse is not in the unit today, but if I wait a moment, the receptionist will find the nurse in charge. After some time the nurse in charge approaches, I introduce myself again and tell her that I was commencing my fieldwork observations today. With a friendly nod, she says ‘Oh, yes’, and walks towards the reception desk, picks up the ward diary and mentions that the consultant nurse had put something in the diary to that effect.

I am asked what I need to do. “Well I just want to familiarise myself to the ward. So if it’s okay I’ll find somewhere to stand, I’ll get started”. The charge nurse asks if I want to store my coat and bag. I say that that would be handy, and she leads me to along the ward, past bed bays on both sides towards the ‘bottom’ of the ward. As we walk, she asks me what my study is about. I tell her it is a study about how nurses use technology. I promptly add that it is not an evaluation; I just want to understand how nurses understand the technology they use. We walk on until the open ward ends at the end of the bed bays, and now we are walking along a corridor flanked on either side with what appears to be offices and store rooms. At the end of the corridor, just before a large opaque glass door, I am shown into an office room. The nurse in charge says that it will be safe to leave my belongings here. She then states that I can prepare myself, and when I am ready, I can come on to the ward. As she leaves, my thoughts are racing, foremost in my mind is that I wished she had stayed and accompanied me back into the ward. As it is, I get my notebook and pen together, and then try to gather my nerves. Coming out of the office, my head is rushing, there seems a million and one things going off, ‘out there’ in the ward environment and ‘in here’ in my head. At a later point I recalled this anxious moment when I read an article by Crapanzano (1977), in which he states the work of ethnography, “is anxiety-provoking, ego-dystonic, threatening to the ethnographer's sense of self” (p.69). In this particular moment it seems all too true.

I walk back up the ward, smiling at those nurses who turn to notice my presence. I take in each of the bed bays only fleetingly. The ward, on my return, now appears like a hive of activity. There are now a number of nurses standing by beds; walking purposely around the ward, disappearing into rooms; appearing from rooms. All dressed in blue tunics and trousers, they carry out tasks that are, as yet, alien to me. As all this activity carries on, I am still in the effort of calming my nerves. I do not know these people; I do not know this environment. Moreover, it is now my job to make sense of it all.

I had only briefly taken in the charge nurse’s appearance and now when I return to the reception space and look around, she is nowhere to be seen among the dozen or so nurses and medics on the ward. I ask the receptionist if she could point me to the charge nurse, whom I had just met. Another male nurse standing nearby says that he will go and find her- I wait. In a minute, the charge nurse comes up to me again, out of the blue (of the mass of blue tunics). We discuss what I need to do. I state that it would be good to find a vantage point where I can observe the ward for the time being, adding that after a time I would like to walk up and down the ward to have a closer inspection of what is going on. We agree on this, and the fact that I will not be expected to enter any bed area that has the screens pulled round. She then leaves me to get on with her work and I am left standing at the reception. I mention to the receptionist, in order to confirm my every movement that I will stand back against the forms drawer, some ten feet immediately opposite the reception. The receptionist asks if I want a chair. “Yes please, that would be handy”. I am given a chair, which I push back against a sizeable set of shallow draws filled with forms. This observation station will become the place I will return to repeatedly to write up notes on my immediate observations and conversations with nurses.

I settle down for this first episode of observations. Initially I will spend four hours on the ward, taking in the sights and sounds like a tourist lost in an unfamiliar quarter of a large city. My notebook is open, and in the first minutes and hours, I jot down everything I witness. It occurs to me that in these first moments of observations my notes are snap shots of events or actions. Everything that is going on cascades on me and then upon the notebook I have just bought for my field notes. After sometime of jottings, I collect my thoughts and ask myself what I am looking at. To centre that proposition I write in my notebook and underline the statement:

*“How do nurses interact with health technology?”*

When I look up to observe the scene, once more the plethora of activities, machines, sounds, people and objects enter my perception and once again, I am caught in the maelstrom of trying to understand what is going on. It will not be the last time, when I will feel the vertiginous sensation washing over me as another tide of phenomena overwhelms my senses.

On this first day, I am introduced to ‘John’, a nurse of some experience. He say hello, and asks what I am doing. I again rehearse my statement, mindful of my supervisors' advice to keep it simple. He asks if I would like a coffee. Saying yes, we leave the main ward, back through the boundary space that is the main entrance and exit to the ward. We are back in the hospital corridor walking towards an opaque glass door at the end of the corridor. Before the glass door, we enter the staff room. There are nurses sitting eating snacks having idle chat, while a large television fixed to the ceiling blares out some daytime TV chat show. John points to the stack of plastic cups, and shows me where the coffee tin is. I prepare a cup and wait while another nurse fills a cup from a water geyser fixed to the worktop. The food and drink preparation counter takes up one whole wall of this room, which measures around 14ft square; chairs are set round the other three walls. In the middle of the space, a low coffee table is strewn with out of date magazines, of the fashion/ home-improvement kind. In amongst the reading material are some ‘in-house’ publications, including one on a local critical-care consortium. As we sit and chat, a few nurses finish their drinks and leave; returning to the ward and their duties. I notice along one wall a notice board with various ICU related documents, along with a poster for a night out, and an advert for a car being sold by a member of staff. On the opposite side of the room to the notice board are the windows, which run the whole length of the room. They look out upon a large quadrant surrounded with similar hospital spaces within. The view is stark, as four storeys of similar brick and window space look in upon itself. As I look out of the window, the low winter sun struggles to illuminate the lower floors.

John and I sit and chat drinking our coffee. I ask him questions about the unit and he answers with considerable patience. I am using his answers and knowledge to orientate myself to the environment; I glean straightforward ‘facts’ about shift patterns; how many nurse are on in a given shift (usually a ratio of one nurse to one patient) and how many male nurses work on the unit. John also informs me of break times, when staff arrive on shift and how the unit is run in terms of changeover meetings and staff teams. John’s knowledge, as an initial informant is valuable information, if only for me to get a handle on the unit. As we finish our coffee, I ask if he would agree to being interviewed for the study. He agrees without hesitation. Pleased to have made in-roads in introducing myself to one member of the team, I accompany him back on the ward through the ‘boundary’. He punches the hand cleanser and I copy him likewise, then he swipes his card from the lanyard hanging around his neck and we enter back into the unit.

In the ICU, I take up my observation post, open my field notebook and observe. As expected, on this first observation session, I am immediately taken by professionals on the unit as a ‘body out of place’: why is there a strange man sitting at reception writing in a book? People are bound to ask questions as to why I am there and what I am doing with my paper and pen. As a requirement of ethics, I had given the nurse consultant, an electronic copy of my information sheet for observations. She had emailed this to all staff (as well as placing them in nurses’ pigeonholes). However, on this first occasion and on many subsequent occasions, I found myself explaining my presence on the unit.

The staff were obviously curious as to the notes I was making in my field book. After explaining for the umpteenth time, one nurse says, “That’s okay- before the Chinese whispers start”.

I have since reflected on nurses’ initial suspicion over my activities, considering how this might have impacted on any subsequent observations and interviews. I believe that on detecting some initial unease from staff over my presence in their work environment, I made as much effort as possible not to appear detached from the social activity of the ward. Although my role was as a non-participant observer I strived to connect with nursing staff by ‘shooting the breeze’ whenever the opportunity arose; joining them during their breaks in the staff canteen and by sharing informally some of the observations I had made.

Looking back, those first few observation sessions held moments of acute anxiety regarding how I might approach people to introduce myself. I was caught between not wanting to disturb nurses as they went about their tasks, and feeling myself rather rude about coming into others’ environment without introducing myself. On that first observation episode, some people did approach me and ask out of curiosity. I was grateful for this as it then gave me a later opportunity to approach them as they went about their work.

In that first fieldwork session, I devised an observation strategy that I mainly continued with throughout the 40 hours of observations on the ward. During all the sessions, I used the observation hub next to the reception to write up notes of immediate interaction with staff. I also used this observation point to gather information about the general coming and goings of the ward routine: a macro-view of the environment. When I wished to observe at close quarters nursing activity or to talk to a nurse, I would rise from my seat and approach them. As a matter of courtesy, I would always ask the nurse if it was convenient. On occasion, nurse expressed that they were too busy to be observed, or enter into a conversation. This, of course, was respected in the knowledge that at other times the same nurse would be happy to allow me close observations of their task, as well as enter into conversation about their interaction with technology.

## The ICU environment

The following describes the physical environment of the ICU (Figure 1). I will map out the main features of the unit as to give a detailed picture of the main sites of nurse, patient and technology interaction.



**Figure 1: Plan of the ICU**

To begin with, the main open space of the unit; it is a large rectangular area, it measures around 11 metres wide by 23 metres in length. When one enters through the main doors, the ward reception faces you across the main ward concourse. The reception comprises a 4-metre length of desk space; on top of the reception desk sits the usual office paraphernalia: a computer with unit; telephones, filing shelf and paper binders. To the left of the desk is situated a printer. Behind the desk space there are a number of cabinets, and fixed shelves; a clock sits high on the wall. Behind the reception, a door to the left takes you in to a storeroom. It is here that gases such as oxygen are stored. I was also informed that this area also contain a locked store for class A medication. Directly opposite the reception, is situated the main double door entrance- previously described. Situated to the right of the entrance doors is another store, which houses medical supplies. Between the reception/store room and the entrance/store room area the open space of the ward narrows to around 4 metres. In effect, this narrowing divides the open ward space into two areas.

Standing at reception and looking down the ward long-ways, one takes in one of the main bed areas [bed area 1]. With the main concourse down the middle, there are four bed-bays to the left, up against the windows that stretch the full length of the open ward, and four bed bays to the right, against the opposite wall ward. Turning around 180 degrees, there is the same layout, with four beds against the wall and four up against the window space [bed area 2]. In detail, the environment resembles the classic Nightingale ward, with bays on each side, albeit with distinctly fewer beds.

At each end of the two bed areas, one and two, the ward narrows to corridor space. Taking in bed area 1 the corridor leads off into an office and storerooms. Immediately on the corridor is situated the ward’s isolation room. One wall of this room faces onto bed area 1 at the window side of the ward. The wall has a large window space through which the activities going on within the room can be observed from bed area 1. Carrying on down the corridor leading from the central concourse of bed area 1, on the left beyond the isolation room, are situated two offices. These are general administration offices, though one acts as a nursing administration office and the other, at the end of the corridor, is for general ICU administration. These two offices would later be used for many of the interviews with nursing staff. At the end of this corridor is a large sliding door of opaque glass. The door is large enough to allow the exit and entry of ICU beds. The area beyond the glass door has a reception space and a lift, which brings patients up to the ICU from other areas of the hospital, mainly surgery and emergency admissions. This area can be described as a further boundary space, as it is clearly marked for hospital staff only. A button near the sliding door allows staff to exit. Entering the ward from this area requires staff to swipe their identity card. Although this entrance is the entry point for bedded patients coming onto the unit, the access also allows staff quick passage to the main hospital entrance and the shopping/café area described earlier.

Returning from this boundary space back onto the corridor leading to bed area 1, there are four more rooms on the left. These comprise of a small room designated as the nurse consultant’s office. The next room is a further storeroom housing medical supplies such as medical kits. The room also accommodates one of the two blood-gas machines on the unit. Historically, this room is described by staff with long service on the unit, as the dressing room, where patients in previous times would have their surgical dressings changed. The last two rooms before entering bed area 1 are used for patient washing preparation and waste disposal. Beyond bed area 1 and the reception and main public entrance, lies bed area 2.

Further on up, the ward again narrows to a corridor with rooms similar in layout. Facing the corridor, on the left is the medical equipment storeroom, which also houses the second blood-gas machine. In this room all the medical equipment and technology used on the ward is kept on shelves and along the floor space. On one counter built against the wall there are a number of pieces of portable equipment. Next to this equipment, battery chargers blink green lights showing their status. On other shelves in this room further medical technologies are prepared for use. Among the larger equipment are the filtration/dialysis machines. Recently new filtration machines have been introduced to the ward. They are not stored here, but in the seminar room across the corridor.

Entering the seminar room, there are chairs laid out in orderly fashion around three walls. A stack of chairs is propped up in the corner. The room also contains some audio-visual equipment and a desktop computer. As the name suggests, this area is used for staff training, and on the poster boards on one wall there is a training schedule, along with newsletters and other training opportunities. There are folders containing equipment and policy manuals placed on shelves on the walls. A flip chart and stand is poised towards one end of the room. There are also the new filtration machines, one still half wrapped. At the time of observing the room, staff were involved in a schedule of training and demonstration of the new machine. The seminar room also hosts the nursing staff hand-overs. All staff coming on duty meet here to hear a report of the previous shift from the nurse in charge. After the main handover, nursing staff break into smaller meeting groups that are assigned to groups of patients on the unit. Following the team report, each nurse coming on shift receives an in-depth hand-over for his or her specific patient from the nurse finishing duty.

One other room in the corridor off bed area 2 is designated as the staff changing room. The room can be accessed from the main hospital corridor. As expected, the room is full of tall lockers for staff to place their belongings before coming onto the main ward.

The above section has described the physical environment of the unit. It is appropriate now to focus in on the patient bed bay. As a site of central importance in nurses’ care practice, a detailed description of the features of this space will indicate the importance of this space with regard to nurses’ interaction with technology. I will highlight typical ‘fix’ devices that make up the ICU bed and its surroundings.

## Technologies on the ICU

I have thus far described the ICU environment, but as it stands these spaces are empty and require populating with objects, artefacts, and human agents. I want to go on to describe firstly the standard forms of health technology that are likely to occupy the unit space. I will discuss ICU beds, ventilation machines and other sundry equipment used in nursing intensive care patients. I will pay particular ethnographic attention to two devices: the blood filtration machine and the blood-gas machine as exemplar technologies. Through ethnographic exploration of my fieldwork observations and theoretical insights from society and technology studies (STS), I will illustrate the nuanced nature of nurses’ interaction with medical devices.

Recent advances on ethnographic methods have explored the central place of technology in social interaction. As Hess (2001) has indicated, much of what counts as classic ethnography of science and technology has hitherto ignored, or at least paid scant interest in, technology as a player in the materiality of social action. Taking their cue from earlier ethnographies from Actor-network theory(Latour, 1987, 1988; Callon, 1986a; Latour & Woolgar, 1986), studies such as Prout’s (1996) investigation of the metered dose inhaler, and Singleton and Michael’s (1993) exploration of General Practitioners and cervical screening , examine the contested nature of technology use in clinical practice and have developed approaches to studying technology in ethnographic detail. At the core of this programme has been an effort to bring parity of agency between humans and technology, by engaging with what ANT writers call the ‘material relationality’ (Law, 2009). Accordingly, what might be described as human and non-human action is an outcome of a contextualised relational performance.

## The intensive care bed

The ICU main ward area has 16 beds (there is one in the isolation room). In each case, an intensive care bed represents a sophisticated technological apparatus. The bed, as one would expect, contains a high degree of articulation across its frame; enabling nurses to position the bed mattress through a push button interface built into the side barrier of the bed. Small pictorial signs reference each button, acting as a guide for nurses when manipulating the positioning of the bed frame and mattress appropriate to the patient’s condition; not least to prevent pressure sores in the patient (Clochesy, 1996).



**Figure 2: Typical ICU bed with monitor and driver on stand**

The intensive care bed is itself a focus of technology. Aside from the rudimentary bed frame, which boasts multiple articulations, automated through motors and pumps, the mattresses also offer a high level of technological sophistication, as one of the nurses interviewed defines it*:*

*Mn01, male nurse: “Well the bed is a piece of technology itself. It goes up and down and side to side. We’ve got more complex beds we’ll use with sicker patients, which can vibrate to help their chest.”*

Above, a gantry runs along all the bed areas. At each bay, the gantry delivers fixed electrical sockets. These are used to power any devices being used for specific patient care. From the gantry is also suspended the monitor, one for each bed. The monitors are a vital source of information on the patients’ physiological status: offering traces on heart rate; blood oxygen levels, blood pressure and respiratory rates. On every hour, it is the duties of the nurse assigned to each patient to record and chart these vital signs. Surrounding the head end of the bed there is a portable trolley, which holds objects of various nursing paraphernalia; used by staff to carry out routine tasks directed at patients’ personal hygiene.

Each ICU bed is the site of sophisticated technological apparatus. Depending on the patient’s illness, the nurse, whose responsibility it is to manage this space will be expected to ensure the functioning of an array of medical technology. In order to have an overview of the technological network, which is interfaced with the patient, the ICU nurse’s observation position is taken up at the base of the bed. There, sat at a high desk, which is on wheels, nurses have an encompassing view of both the patient and technology that surrounds them. On the desk, which has a slanted surface, is the large observation sheet, made up of separate charts for each physiological observation- heart rate, blood pressure, ventilation etc. Of course, there is order and purpose as to the position of the nurse in relation to the patient and monitoring devices. I record in my field notes that:

*I’m observing the nurses attending to patients on the left side of the ward. Three of them are sitting at their respective desks. One nurse is busy recording her observations. She looks up from the observation sheet towards the monitor and then records the figures. Again, the nurse gazes at the monitoring device, and then returns her attention to the observation sheet. It seems to me that the position of the observation desk seems apt for both patient and technological scrutiny.*

Later that same shift I speak to one of the nurses about the position of the desk in relation to the patient.

*Mn17, Male nurse: “Well you can see everything…I look at the monitors before I look at the patient. We’ve got a few things to record, so here you can get it all down at the same time.”*

I notice after regular observation that most of nurses’ time, when they are not working around the patient, is taken up with sitting at their desk. From here, they might chat to other nurses also sitting at their desk, or indeed visit other nurses’ desk to chat. It is in effect the nurses’ area of domain. From this station, nurses operate the panopticon of the nursing gaze. Every item of technology - monitors, syringe drivers, ventilation machines, is ordered and positioned to serve the observational requirement of ICU nursing. Furthermore, the patient is revealed and ordered in the medical gaze through the myriad of technology that discloses knowledge of the inner illness. Noted by Henderson (1994), using a Foucauldian perspective, the panopticon of the medical gaze in ICU demands the subjection of the body to technological scrutiny for the production of knowledge. However, like all panopticon, the scrutinising gaze is reflected back upon the observer, in this case, the nurse. In the network of patient technology, the nurse is also ordered through the regular requirement of routine observation (Epling, 2003). The observation sheets, and other similar nurse recordings, becomes objects through which nurses are scrutinised (Timmons, 2003). This panopticon, reflected back on nurses, was made clear to me when I asked what was done with the observation sheets besides recording the ongoing physiological status of the patient. I was informed by a number of nurses, that completed sheets were regularly taken away and checked for auditing purposes. As one nurse put it:

*FN 14, Female nurse: “So they can see if we’re completing them properly. And if anything is disputed about the care people have received here.”*

## The ventilation machine

Under direction from medical staff, nurses operate a plethora of medical technology; these may be deployed at the bedside of patient in accordance with the condition and the life-support needs of the patient. Among the technology most cited by nurses in interview is the ventilation machine (see figure 3). The devices are of course stand-alone portable devices, used to support the respiratory function when the patient, due to their medical condition, is unable to breathe on their own. The control of ventilation is managed through an interface screen, which displays particular features of the patient’s respiratory rates. With particular therapeutic interventions required in accordance with the patient’s condition, the nurse is able to take ‘readings’ from the computer screen and make adjustments in line with the consultant’s prescribed therapeutic regime.



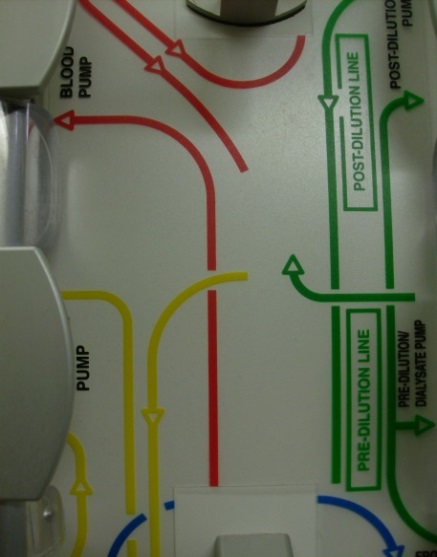
**Figure 3: Ventilation machine**

## The blood filtration machine

Continuing with the potential catalogue of bedside technology, nurses may be called upon to set up the Aquarius filtration machine (Figure 4). Of all the technology described by nurses, according to interview testimony, this is the most sophisticated device they have to work with, and the one that requires a great deal of attention to ensure it is functioning correctly and efficiently. Similar to other devices the machine is portable and stand-alone and is brought to the bedside when required. The machine stands on a metal frame, and the main section of the filtration machine - trade name Aquarius - presents a configuration of cam pumps, which push the patients’ blood through the filter. In setting up the various tubing and conduit lines, the user is assisted by coloured lines reflecting the correct pathways for the tubes (Figure 5). Marked onto the front of the machine, these distinctive coloured lines of blood direction have topographical representations that bear resemblance to Beck’s famous London Underground map (figure 6).



**Figure 4: Aquarius ventilation machine**



**Figure 5: Close up, filtration tube pathway**

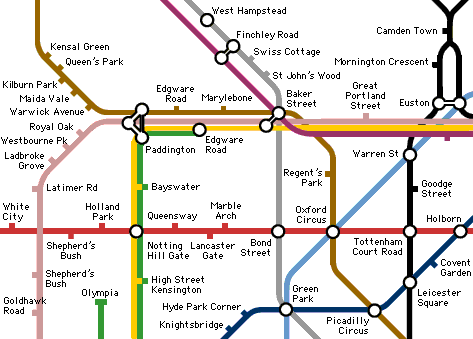
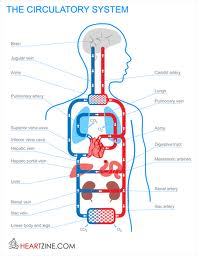


Figure 6: London Underground map, Harry Beck 1931[[1]](#footnote-1)



**Figure 7: Diagram of circulatory system**

Although no direct mapping of the Aquarius machine’s filtration pathways can be directly construed from the figurative diagrams in figures 6 and 7, the similarity of ‘text’ and the mode of representation i.e. uncluttered symmetry, reduction to salient features of the system, is one we are all familiar with today in modern design vocabulary. In particular, nursing and medical students, through their training in physiology, would be familiar with the diagram of the blood circulation system represented in figure 7. It is the designer’s use of a particular and recognisable representational form, which ensures the correct placement of the conduit tubes on the Aquarius filtration machine.

Technological configuration in design co-opts those using the device. It is an indicative example of what ANT theorists consider a translation of users into the network of the filtration machine. This is to say that the design’s resemblance to similar features of other technologies taps into recognisable forms- be they transport maps or physiological texts books - which ensures the opting in of nurses as users of the filtration machine. The key point here to note is that all those who are recruited into the network, which by definition contains multiple interested members including technology designers, health policymakers, filtration machines as well as nurses who use the machines, all work as heterogeneous engineers (Law, 1999). The following quote from Law (1999) sums up the ANT approach to social and technological relationality:

*“Actor-network theory is a disparate family of material-semiotic tools, sensibilities and methods of analysis that treat everything in the social and natural worlds as a continuously generated effect of the webs of relations within which they are located. It assumes that nothing has reality or form outside the enactment of those relations. Its studies explore and characterise the webs and the practices that carry them. Like other material-semiotic approaches, the actor-network approach thus describes the enactment of materially and discursively heterogeneous relations that produce and reshuffle all kinds of actors including objects, subjects, human beings, machines, animals, ‘nature’, ideas, organisations, inequalities, scale and sizes, and geographical arrangements.”* (p.2)

In any given context of relationality between these actants, in this instance, nurses and filtration machines, actor network theory insists that the heterogeneous engineering is as much an achievement of the technology as the nurse. It is the design of the technology, as one component of the network, as material-semiotics (Law, 1992) that is to be ‘read’ and thus more or less understood by the nurse using it, that enables a point of heterogeneous engineering of the nurse into the network of blood filtration. Of course, this is not to ignore the other members of the network who can be traced back from this moment of technological use by nurses. However, this moment of technological adoption suggests a ‘natural history’ of both the technology and the nurse as members of the blood filtration network. Much of what I write about with regard to nurses’ use of technology contains this element of network recruitment, which helps to stabilise the network and ensures the continued use of the technology. However, I will add a note of caution: the semiotic nature of technological use affords a dynamic reading of the technology, in that not all understanding and use of the technology might be in line with the technological affordances insisted upon by the technical network. In some circumstances, nurses’ ‘reading’ of the technology opens up alternative uses of the technology that address social affordances beyond the stable network of blood filtration (Hutchby, 2001). There is more to be discussed on nurses’ work with filtration machines. I will leave this for a later chapter where I present the findings from interview data. At that point, I will further elaborate on ANT in relation to the analysis of nurses’ accounts about the different technology they use.

## *Prismaflex*- the new state of filtration technology

At the point when observations commenced, the ICU was in the process of moving over to new filtration machines. The technological innovations of the new filtration machines included a computer interface that takes the nurse through the various steps, ensuring each step is completed in accordance with the requested filtration procedure. The new filtration machines - trade name ‘Prismaflex’- like the older Aquarius machine has a built in computer interface. Comparing both interfaces, the Aquarius screen presents the user with options as to the particular filtration prescribed. This presentation is similar to the Prismaflex, as each option button on the touch sensitive screen takes the user further into the set up. While in operation, both machines give a constant report on the status of the filtration cycle, alerting the nurse to particular calibration requirements that have to be carried out to ensure the correct function of the machine. Throughout the filtration procedure, which might take up to three hours or more, a sizeable part of the nurse’s time is taken up with maintaining the technology to ensure correct filtration.

In what was described as a step forward, the new Prismaflex differs from the old technology in its ease of setup and operation. The interface platform is made more user-friendly with the step-by-step screen pages resembling the familiar pages of a Microsoft windows programme, with touch screen radio buttons assisting the nurse through the various filtration options in the set up. The Prismaflex boasts the ability to change between different filtration therapies without reconfiguring the filter. The new Prismaflex offers greater safety features that ensure correct use in terms of fluid outputs and inputs to patients. As expected, the literature accompanying the device, lists developments in the technical features of the new filtration from previous filtration devices, with emphasis placed on the science of filtration. Adhering to the discourse of science to sell the appliance is an important strategy in building support among professionals who will use it. Whether those professionals, who will eventually apply the technology to patients, are fully knowledgeable as to the intricacies of science, technology or electronics behind the practical use of the machine is perhaps secondary to their acceptance of ‘science’ qua science, as a powerful mediator in technological adoption. The use of science ‘talk’ is a powerful discourse that, “in the first place is the conflation of knowledge and truth” (Aronowitz, 1988, p.vii), which through its realist methodological insistence of direct knowledge of the world of ‘truth’ and ‘reality’ demands acquiescence from society.

Certainly particular members of the nursing and medical staff responsible for its use will rely on science talk as an acceptable guarantee of the machines effectiveness; again, semiotic-materiality is at work in providing a reading of the technology that ensures the recruitment and translation of actors into the network of filtration. The following text (Figure 8), taken from literature on the Prismaflex, highlights the machine’s effectiveness couched in the language of science of renal physiology:

**The Prismaflex system** offers three types of membrane for CRRT (AN 69, AN 69 ST and PAES) with three different surface areas for each membrane.

**Therapeutic plasma exchange and hemoperfusion\***

The Prismaflex system can fulfil the needs of both adults and children for therapeutic plasma exchange and hemoperfusion, since it is compatible with two different sizes of membrane surface area and cartridge.

**Innovative membranes for new possibilities in blood purification\***

OXiris- a Prismaflex set with unique membrane ability to adsorb and remove endotoxins

SepteX- a Prismaflex set featuring a proprietary Gambro high cut-off membrane technology, able to remove and reduce plasma levels of high molecular weight toxins (e.g. cytokines)

**Optimized combination with the MARS liver support system**

The Prismaflex exceed II system provides a unique compatibility between Prismaflex and MARS systems by means of a dedicated user interface and a specific-MARS kit to simplify the treatment of patients suffering from liver failure.

(Published by Gambro Lundia AB, retrieved from www.gambro.com June 2011)

**Figure 8: Prismaflex- highlighting the technology in renal physiology**

As Pinch and Bijker (1984) suggest, the successful adoption of new technologies requires the investment of a relevant social group that coalesces around the artefact giving it meaning and function relative to the needs of the specific group. Nevertheless, calling up science as a discursive strategy to insinuate the effectiveness of the filtration machine is only half the story. Not all users and members of the relevant social group will be in possession of science knowledge. There is therefore the need to frame the effectiveness of the device in language appropriate to the requirements of other group members. The requirements of the technology may be other than scientific, they may require an appeal to discursive constructs surrounding societal notions of expressive care and concern for human life, or the effectiveness of the technology to provide more time caring directly with the patient. From the same document, the following excerpt (Figure 9) can be said to appeal to these very aspects of nursing practice as a form of expressive care and human endeavour:

*Hundreds of thousands of men, women and children around the world… rely on our products and your care to survive kidney or liver conditions and enjoy a better life. Every step we take together, every improvement in care we make, touches lives and provides new hope ... Gambro—the pioneer and leading innovator in dialysis therapy passionately committed to promoting life by advancing products, services and customer partnership within renal and hepatic care…*

***Quick and easy to use***

*The Prismaflex system incorporates a 12-inch color touch screen with an intuitive user interface. This provides constant monitoring of prescription delivery thanks to the clear display of all necessary parameters on the status screen. Step-by-step instructions on screen make set-up easy. Each step is accompanied by an illustration with color codes matching the color-coded hemofilter sets. Any prescription change can easily be made with clear accessible softkeys.*

(Published by Gambro Lundia AB, retrieved from www.gambro.com June 2011)

**Figure 9: Prismaflex- highlighting the technology in nursing care**

The brochure goes on to state that with ease of use the Prismaflex® gives more time to be with the patient as well as reducing workload and stress.

With the example of the *Prismaflex* filtration machine (Figure 10), I want to suggest that there is a double epistemology between the scientific and the social, which strives for a symmetry of technology, similar to Bloor’s studies in the Strong Programme of scientific knowledge (Bloor, 1991; Pinch & Bijker, 1984). That is to say, technology, in order to be successful, has to ‘work’ in the realms of the science-world and in the social-world. In this way, designers and manufacturers as heterogeneous engineers in the filtration network have to appeal to the social component to ensure that the machine is adopted by all the relevant social groups likely to enter the filtration network orbit. To this end, the device may succeed as a black-box ‘technology’ in that the electronic and computational infrastructure ‘work’, and ensure the machine functions according to its technological affordances. However, as a social object it may never be taken up.



**Figure 10: Prismaflex dialysis machine**



**Figure 11: close up of filtration apron**

While the transition from the older Aquarius machine to the Prismaflex was taking place, there were a number of demonstration workshops offered to nursing staff to familiarise themselves with the technology before they were expected to use it on patients. I was able to observe two of these workshops, conducted in the seminar room, which were run by a sales representative from the company selling the machine. The demonstrations lasted forty-five minutes. Within that period, I observed the sales ‘rep’ appealing to both epistemologies - the scientific and social in equal measure. The demonstration highlighted the functionality of the Prismaflex in terms of the renal therapy regimes that nurses and medical staff would most likely use, and illustrated the effectiveness of the machine to manage the patients’ therapeutic requirements. At other times, the demonstration would concentrate on the practicalities of handling the machine, including the positioning of fluid bags at a level that lessened the physical effort nurses were required to undertake when disposing and replacing bags.

Similarly, much attention was placed on setting up the machine and the ease of situating the integrated filtration kit by means of colour-coded tubes and corresponding insertion points. The sales ‘rep’ focussed on the ease with which the device could be set up, to enable the nurse to spend more direct care time with the patient, whilst the device worked discreetly in the background. In this respect, the demonstrator attempted to contrive a narrative that places the technology as affording greater social interaction through discursively positioning the patient nurse relation at the centre of care. I noted in my field book at the time:

*Field notes- 10/1/11*

*The device trainer attempts to relate his understanding of the needs of the nurses to have useable technology free from complexity and complications.*

*The nurses are talking about the problem of picking up on the new machine when they have got used to the old one- with all its foibles. The demonstrator then manages this situation. He expresses his understanding that change requires new skills, but while necessarily distancing the new technology from the old, to ensure that nurses are to some degree comfortable with the new device, he has to sustain the idea that practical knowledge of the old device will help the nurses understand and manage the new machine.*

*.*

*The conversation now surrounds the trainer/demonstrator negotiating the nursing and technology communities. His job is to introduce the technology by making it meaningful to their practice.*

*As the trainer goes through the set up on the screen, I notice that nurses start to voice unease at the apparent complexity of going through the different platforms and menus on screen. One nurse mentions, to no-one in particular, that “you’ve lost me.” In his response to this- and other comments of evident strain and confusion- the trainer mentions the words “not to fear” in relation to the use of new technology. The trainer promises to reduce this apprehension by offering a continued period of support: “I want to be around to help set it up with patients”… “I’m a phone call away if you have any questions”…He also mentions that for a period of time he will be on hand to assist with the setup while the AICU is getting used to using the new machines.*

*The trainer/rep mentions to the group that he worked as an ICU nurse. He is managing this performance by engaging nurses with the technology by using his own experiences to highlight that he understands what ICU nurses need. So, he relates stories of nursing with technology that was useless in delivering safe patient care.*

I recorded at the time of attending the demonstrations of the Prismaflex filtration machine, that the trainer/rep performance was exemplary in its effort to engage the nurses and helping them opt into using the new device. He used a number of strategies that ‘spoke’ to the concerns of nurses. Foremost among these strategies was revealing his nursing credentials. As an ICU trained nurse, he was able to empathise with nurses through sharing in stories around nursing technology.

I want at this point to pick up on what is happening here with regard to this intersection of the Prismaflex filtration, the sales representative and the nurses who will go on to use the technology. I would argue that the sales-rep is operating, in ANT terms, as an actant boundary object, bringing together the worlds of design and manufacture on one side and the network of technology and nursing in the ICU. Usually there is no limit as to what can be counted as a boundary object. Studies that have used the concept of a boundary object have presented divergent phenomena as the focus of investigation. For example, Fox (2011) and aseptic technique in surgery; Eden (2011) and food labelling; Harvey and Chrisman (1998) use geographic information systems as boundary objects to inform the transference of information between GIS technology and social groups. As Star and Griesemer (1989) point out, what is important to the function of boundary objects is that they offer a common representation across divergent fields of knowledge. Although Fox informs the debate by suggesting that boundary objects might reverse and indeed cause the discontinuation of interactions across discipline boundaries (Fox, 2011).

Although it appears that boundary objects take the form of hard material artefacts, or conceptual ideas, in this instance, I am suggesting that the sales rep (as actant) acts as the boundary object. The rep, although working in the technology industry, is a registered nurse. In the interaction with nurses, the rep was able to demonstrate his practical knowledge of nursing to translate the contents of the technology (which encapsulates the knowledge of the medical innovations industry) into the practical concerns of nurses. As such, he is able to intersect the two worlds of technology design and the ICU nursing. This knowledge claim: “I am a nurse,” operates the easy transition of the new filtration machine across network limits, (speculatively, it could be inferred that the industry employs qualified nurses for this very reason) resolving resistance and incoherence’s between the knowledge community of design and manufacture, and the practical knowledge of the ICU nursing world. To do this, as the notes from the Prismaflex training suggest, the rep works to relate the view features of the devices with the existing practical knowledge that already circulates in the ICU network. It might be argued that the new filtration device is the boundary object. However, as I analyse the interaction, it is the rep who is working to inscribe the functionality of the machine into the nurses’ normal interaction with filtration technology.

I now wish to describe one further scenario of nurse- technology interaction. In the following example, I will seek to analyse the way that technology orders the activity of nurses. This case looks at the boundary space at the ward’s entrance, where mundane technology (Latour, 1992) - chemical hand gel - informs the nurses’ performative actions around the science of infection control.

## The ICU main entrance: negotiating a hygiene boundary

The visitor enters the ICU ward through two sets of double doors. After the first set of doors, one enters a box-like anteroom approximately 2 metres by 3 metres. The doors entering the ward area immediately face you as you come through the first set. The double doors act as an ‘air lock’ that separates visitors from the main hospital corridor. In this area, there is a certain feeling that one has come into a space of transition, from the hospital thoroughfare with its potential to deliver pathogen contaminates to another space where ‘dirt’ is left behind. This area works as a transition space both symbolically and physically, a constructed watershed separating an *out-there-ness* of potential contamination, and the *in-here-ness* of cleanliness.

These boundaries act on, and are performed through, the symbolic ordering and separation of the ICU environment, from the world outside. By the very nature of the representation in this closed space between out and in, cultural notions of ‘dirt’ and its impurity are brought to the fore. There are posters on the wall alerting visitors to infection control. Standing against the wall is a full size figure of a female nurse with her hands displayed open. The openness of hands, as well as evidencing cleanliness, works on the individual as a signifier of honesty. To harbour infectious pathogens, and to ‘secret’ and ‘secrete’ them in to the ICU is to be dishonest and under-handed. Moreover, this signifier charged area, creates a further symbolic ordering, this time between the scientific war against disease and dirt, and the everyday secular activities, which accrue dirt. The science and the technology used in this boundary space which enforces the practices of purity and hygiene, relies on the cultural significance of ‘dirt’. These matters cannot be written about without recourse to Mary Douglas, and the cultural anthropological significance of dirt being ‘matter out of place’ (Douglas, 1966, p. 35). The following quote from Douglas (1966), addresses neatly the material ordering that occurs when entering the ICU:

*“Where there is dirt there is a system. Dirt is the by-product of a systematic ordering and classification of matter, in so far as ordering involves rejecting inappropriate elements.”* (p.35)

The importance of symbolic ordering of out-there-ness as ‘dirty’ and in-here-ness as managed and ordered purity, compels visitors and staff to use the disinfectant gel, which is dispensed from the hand machine fixed to the wall. In addition, this space between the corridor and the ward displays posters requiring visitors, both relatives and professionals, to be aware of infection control. There is, of course, a materiality to this liminal space between the scientific and technological controlled purity of ward-world, and the pollutants of the ‘social’ world. Of course, both spaces are social, but the symbolic ordering constructs the significance of an ‘other-world’ of the intensive care. The materiality lies in the compelled enactment of cleansing practices: reading the information posters; taking a squirt of hand cleanser. All who visit the ICU must engage with this enactment of purification. If indeed, dirt is matter out of place, the harbinger of this pollution is people. More particularly, the volume of traffic made up of nurses going to-and-fro from the unit.

Much of what is going on in this area is directed at controlling bodies. This is to say, what kind of bodies should be entering the ICU and how other bodies are controlled is an important function of this ordering. Along with the infection control posters, there is the visiting times schedule, laying out the hours when people can visit, and what is expected of visitors’ conduct while on the unit.

All of these matters are materially important with regard to the clinical management of infection on the unit. However, control of infection as ‘dirt’ can at times be a two-way-street. During the phase of my fieldwork, a new sign went up. It warned pregnant women that there was suspected swine flu in the ICU. In this instance, there is a reversal of the symbolic order - the ‘dirt’ is now within the unit.

This management of human traffic is underscored by a set of values that are informed by the actor-network of microbiology (Rawlings, 1989). In turn, the theory of microbiology and infection are transmuted through the network made up of laboratory work, policy-maker, protocols, chemical manufacture, and nurses and so on. All these heterogeneous actants are enrolled into a network of hygiene practices, ensuring the people, objects and environment involved with intensive care practice are kept as sterile and hygienic as possible. Thus, a set of practical rules, informed by microbiology, *to some extent*, ensures the hygiene conduct of all within the ICU space. However, as Rawlings (1989) indicates, rules of hygiene compliance are in a sense only symbolic representations of the underlying complexity of microbiology, and as such, socially situated performative hygiene practices- *to some extent*- cannot fully cover all of the underlying materiality of microbe theory. Rawlings (1989) writes:

*“Because of this symbolic rather than direct relationship, members of the organisations involved in producing and maintaining sterility treat the rules as practical features of the setting, to be invoked, suspended or followed with reference to other contextual features, such as who is involved…”* (p.281)

As a ‘novice’, naïve to the symbolic performance of hand cleansing, as I enter the main environment of the ICU, I carry out all demands of infection control to the letter. Oozing out a sizeable gob of liquid, I rubbed my hands together for some 20 to 30 seconds until the solution had evaporated. For me, as the new actor on the scene, this space between worlds seems focused on infection control, and I comply with the demands asked of me. I am thinking that all visitors must go through the same action that marks our embodied presence as suffuse with contaminant risk. We are polluted in dirt and we must pass through the purifying boundary space. As I enact this hygiene rule, I question myself about how much is enough hand cleanser. Do professionals entering the unit do it properly? Surely, their practice is more in line with infection control and microbe theory.

As part of my observations, I spent some time focusing on this boundary space and nurses’ performative action around this particular site of infection control practice. The following extracts are from my field notes:

*A nurse arrives at the double door; she quickly knocks the inverted pump dispenser, rubs her hands together, then reaches for her swipe card to open the door…*

*The nurses is carrying some portable equipment, they prop it on the ledge whilst they pump the dispenser rapidly. They wipe one hand over the other reaching above the wrist, take hold of the equipment again, and enter the unit.*

*I’m at the doors outside the unit, about to buzz for entry. A nurse joins me in the space between the two sets of double doors. She pushes the pump once and the wrings her hands together in a quick and inattentive manner before opening the door and letting me enter first.*

There were numerous times when I observed this action, and on each occasion, it seemed that individuals had established their own response to the demands for infection control. I will come to notice nurses, medical staff, and ancillary staff, paying only cursory attention to the use of the hand dispenser: a symbolic squeeze of the pump followed by a quick wringing of hands will suffice, before swiping their card and dashing through the door.

Finishing the above quote from Rawlings (1989), this description of nurses’ actions as they negotiate this boundary between out-there-ness (socio-pollutant) environment and the in-here-ness of the ICU (techno-science hygiene), perhaps testifies to the exigencies of ‘real’ world intensive care practice:

*“This is not to make the practical accusation that rules are deliberately flaunted, but to note that the meaning of a rule is a matter for the situated practical judgements of the people concerned.”* (p.281)

I take this assertion by Rawlings, to mean that action towards rule following is a matter of contextualised judgement. The contextual judgement of nurses being that in order to enter the ICU they have to comply with the boundary rule to wash their hands. The hand-wash dispenser, to use Callon’s description has become an ‘obligatory passage point’, where compliance to the ordering of movement is necessary to crossing the threshold between the ICU and the wider hospital environment. However, in following the requirements, the nurses’ performative action only adheres to the symbolic notion of infection control. The action has become habituated into nursing routine on the ICU; it is something that nurses’ bodies are made to do by the technology of hygiene.

However, there is a further dimension to these infection control efforts. Not bringing cotangents into the ICU suggest a certain moral compulsion upon nurses’ practice (Brown et al., 2008). After all, ensuring the safety and wellbeing of others has a social moral component- cleanliness is next to godliness. In terms of cross infection, the NHS has seen a rise in hospital based infections (for example MRSA- methicillin-resistant *Staphylococcus aureus*); tackling the problem through introducing protocols for hand washing regimes (Pittet, 2001). However, Pittet’s study discovered that health workers are pretty poor at hand washing, indicating that alcohol-based hand rubs are more effective in the management of cross infection. The point I want to make here links with Latour (2000), that the moral action imbued in infection control has now been prescribed onto technology. The outcome or effect of this network of infection control is that ICU must comply with hand rubbing every time they enter the unit. The technology enforces the mortality back on the nurses, by controlling their embodied symbolic action through the boundary space between the ICU unit and the wider hospital.

Meaningful symbolic actions performed by nurses in interaction with ICU equipment will become a significant feature of the interview findings presented later in the study. That is to say, knowledge is constructed as a springboard for meaningful activities by nurses in the context of technological devices. I have thus far offered a description of the hospital and a detailed description of the ICU.

Within the ICU domain I have presented a number of object ethnographies, where I described the main features of the major technology used in the ICU. I have attempted to show how these technologies are taken up by nurses. I also concentrated on the boundary spaces of the ICU, suggesting that they are imbued with symbolic properties that use intervening technology (hand cleansing) to reinforce medical boundaries. I also hinted that as well as ICU staff principally ordering and negotiating the technological environment of the ICU, the actually technology has a part to play in the social and moral ordering of the ICU. In the next section I will take a closer analysis at how technology in the ICU might be seen to further determine the conditions of nurses’ practice.

# Chapter Five- Nurses’ Technological Dependency in Practice

In this section I will explore those conditions of the ward environment which indicate that ICU nurses are, to some extent, determined by the technical necessities of the devices that they use. However, the theoretical ideas of technological determinism are perhaps too reductive in explaining the array of actions nurses perform around medical technology in the ICU. Instead I will focus on exploring nurses’ *dependency* on technology. Nurses and medical staff are indeed dependent on numerous high-tech devices in order to carry out their duties and I wish to demonstrate that by adopting the term dependency, which to my mind has more to say about real social relationality, I can reveal the actual layered and nuanced interaction between nurses and machines. Interactions which are revealed to be never wholly absolutely determined and occasionally carried through with forms of subtle technological resistance on the part of nurses.

Forms of technological dependency can be discerned in numerous interactions between nurses and technology on the ICU. To begin with nurses will describe their duties as ‘looking after organs’, the implication being that the technology and its management forces nurses to look upon the patient as an assemblage of organs. This may lead to a certain splintering of nurses’ image as holistic care providers.

The second section will continue this theme as nurses talk about ‘chasing numbers’. There are a number of ways in which this expression is used; however in each case its use suggests that nurses (in their interaction with technology) endeavour to balance numbers as a representation of the patients’ physiological systems. In both themes, chasing numbers and looking after organs, the analysis shows that the technology directs the nurse’s actions and understanding. It frames a set of discourses about the patient that not only gives a label to the illness, but also constructs a perspective which leads to *Interpellating* - in the Althusserian sense (see Althusser, 1970) - the embodied subjectivity of nurses in their contextual interaction with technology and the patient being cared for. It becomes a culture of normative expressions of talk and actions, not only about the patient in terms of their condition (related to physiology and anatomy) but also in interpreting the patient as actants in the nurse-patient (organ)-technology network.

In the third part the findings reveal how looking after organs and chasing numbers correspond to the idea of ‘balancing technologies’. Effective treatment of ICU patients is summed up through a balancing of technological outputs (such as monitoring and blood-gas tests) and technology inputs (like ventilation, infusion and filtration). Therefore, notions of patient care emerge as an exercise in balancing the network of technologies that interact with the patient.

The fourth section explores the notion of technology as a ‘hermeneutic device’ (Ihde, 1998). Whether the nurse’s action is tied to technological interventions as inputs, in terms of ventilation or blood filtration, or monitoring outputs, as in nursing observations or blood-gas analysis, the technologies used in ICU play a distinctive role in nurses’ understanding of their patient. As Sandelowski (2000) has explored these technologies constitute hermeneutic relations - as an apparatus for gathering knowledge of patients’ anatomical and biological features which hitherto are undisclosed to direct visual scrutiny of patient’s condition, but which nonetheless imprints a new set of readings of human illness and technological interventions. I explore in detail how all this might be the case; about how nurses become dependent on forms of technology that allow them clinical ‘observations’ at the cellular level, and about how such knowledge informs the way nurses view their patients and the tasks they perform to carry out their care role.

## Looking after organs

The expression ‘looking after organs’ has all the appearance of an analytical category or convenient metaphor to describe, and then theorise on, the everyday perspective of nurses - it is however the direct and personal assessment of a nurse captured during an observation of her going about her duties in ICU. It is in this respect an ethnomethodological standpoint adopted by the nurse, it is the way that she makes sense of her world of patients and technology. Whilst she utters this meaning to her actions she is going about the activity of recording the patients ‘observations’; she is doing, as the ethnomethodologist would say, recording technological outputs as indicators of organ status. It is not that the sense of the action is interpreted after the action by the nurse, but that the meaning and sense of the activity are in the action and its indexical context (Atkinson, 1988). The numbers she records are taken from the various machines set around the patient’s bed, numeric values produced by the technology, which give the nurse an indication of the particular organ status. When pressed on this self-representation of her nursing practice as ‘looking after organs’, the nurse explained:

*Interviewer: “You mentioned when I was talking to you earlier that you looked after organs. And I thought that’s an interesting way of looking at things…kind of technology and organ.”*

*Fn07, female nurse: “Well we’ve got technology for each organ. We’ve got technology for your kidneys if you’ve got renal failure, have you seen our new dialysis machine? You’ve got technology for your heart monitoring, your blood pressure and all of that. What else have we got? Technology for a head injury, your monitoring for that and your invasive line that you stick in. Yes it is organ orientated.”*

*Interviewer: “Therefore, the technology gives you an outlook on the patient as being… I might be wrong and come back at me, but it’s like the patient as an assembly of organs that the technology determines the way that you look at them in order to ensure the balance of these particular organs.”*

*Fn07, female nurse: “Yes.”*

Necessary to the purpose and function of the technology, where each machine has the specific task of maintaining or monitoring the function of a particular organ, the technical aspect of setting up the device and its ongoing maintenance directs the nurse to apprehend patients as a series of technological balances. As a perspective on the role of ICU nurses, I was interested in discovering if other nurses shared this interpretation.

*Fn13, female nurse: “I think for some people it’s easier to imagine that you are just tinkering with machines, that you are just helping fix different parts of somebody. Because it’s easier to think that than to think this is someone’s mum or dad or brother. It can be quite difficult if you know that you're fighting against the tide to save somebody, and you're thinking this could be my brother or my dad, it's quite a difficult thing.”*

In the quote above the nurse shares the sense of ICU nursing being about looking after something that is categorically detached from the notion of a patient. Through sedation the patient is framed as something other than ‘social’. As the interviewee points out ‘…we don’t meet the person’, but how is this possible when the person, the patient, is directly in front of them? In effect the patient’s social identity is subsumed within the network of technology and organs. It is by this configuration, where medical devices relay information from the different organ systems, that nurses take their cue. The following comment comes from a nurse when asked to sum up her nursing role. The notion of the ‘person’ as patient is configured in network of organs and technology:

*Fn19 female nurse: “We try to get that person back to health by supporting different organ systems. And generally as a nurse within that, running the day to day tasks of the infusions; keeping the ventilator settings stable, taking the blood gases…”*

In these moments, a technological determinism shapes the interpretation of the patient and indeed the totality of the ICU nurse’s role. There is a direct dependency on medical devices to reveal evidence of the root cause of the patient’s illness, evidence which is not present in observation of the body surface (although of course skin pallor as well as the touch and feel of the skin can be observed). This direct technological, visual observation reveals information of underlying pathology and it is here that the technology within ICU comes into its own; such is its sophistication in revealing the anatomical condition. A stronger argument would be that due to the patient’s condition nurses are directed in a profoundly meaningful way towards understanding the patient illness by means of the technology.

*Fn13, female nurse: “…It’s sometimes easier to detach yourself by thinking of the person as something you need to fix like, with the machines that you've got try to work out how to fix them.”*

In subsequent interviews I used the notion of *looking after organs* to surmise nurses’ view of technology and the way that it might direct their perspective on patients. When nurses considered this idea there was a consensus that they may indeed be being directed by the technology to perceive the patient as an array of fixable organs. The following quotes from different nurses exemplify this point:

*Interviewer: “One of your colleagues said 'what I do is look after organs'. What do you think of that idea?”*

*Fn05, female nurse: “Yes I suppose that’s a good way of putting it really because one machine takes over one organ and they all need to be working together in order for the patient to survive so yes that’s a good way of putting it.”*

*Interviewer: “There seems to be machines for hearts, for lung systems, for kidneys. All these devices in a sense let you know about the patient?”*

*Fn14, female nurse: “Yeah that's true. But it's not just technology like that though. We have people who come in to do echo cardiograms or chest x-rays. And that gives you an even bigger picture of their physiological anatomy. That adds to the technology, not just the technology we look after, but technology that comes in to the unit. That helps look after their organs in another way.”*

The latter extract [from Fn14] has all the qualities of an actor-network. Mention is made of further actants extending out in to other departments in the hospital. Each one is recruited onto the network: radiographers, x-ray machines, heart specialists, medical engineers, nurses, patients, and hearts. This actor-network of machines and humans, it is supposed, work towards the treatment and cure of the patient as a focus of their expertise and specialism. However, the patient in the network is no longer a whole and autonomous agent but rather disassembled as a further network array of organs and tissues. Each component of the patient network is co-opted into the wider socio-technical network made up of specialists with their technological devices.

## Chasing numbers

*Fn, female nurse: “So we are chasing whatever numbers and you can spend a whole day chasing numbers and trying to just find the little thing that gets these numbers right.”*

During periods of observing nurses I noticed that an important component of the care routine involved documenting readings from the various devices connected to the patient (collected on a patient observation sheet). As one nurse pointed out in conversation, "ICU is monitoring intensive, probably more than any other department in the hospital". Undoubtedly due to the critical medical condition of the patients nurses require a constant stream of information to inform them of the status of their patient. If ‘looking after organs’ through the network of medical technology is the nurses’ self-reported focus, then ‘numbers’ are vital actants in the network link between organs, monitoring technology, and care intervention.

*Fn13, female nurse: “…the numbers that we have on the monitors, because we do a lot of watching numbers and you do think how did I get by without having these in front of me before.”*

Numbers flow through the network, they are output artefacts in the form of filtration fluid levels, heart rates, temperatures, blood-oxygen test results, Ph. levels, to name a few. As inputs, by way of treatment they can be a syringe driver, drug amounts, ventilation delivery in cubic amounts of oxygen, fluid giving in millilitres.

These numeric actants flow through techno-networks. The technology-patient nexus is the site of their construction where devices turn anatomic and physical actants: hearts, lungs, blood, into numeric values, which are delivered to nurses through electro-digital transformation into further interfaces in the network, such as monitors. Here nurses ‘read’ numbers on computer screens in papers readouts. At this point nurses are at work interpreting numbers in order to input other numbers into yet more devices for the purpose of delivering treatments to patients, such as oxygen levels through ventilation machines, or bolas drug prescriptions by way of automated syringe drivers. This description of the patient-technology-nurse network in which numbers play a vital role is evident in the way nurses interact with the technological systems within ICU. The following extract from my field-notes typify this, as a nurse observed taking blood describes the task of ‘reading’ technology, documenting values and interpreting those results as ‘chasing numbers’:

*Field note entry date 17/10/10*

*The nurse stands next the patient and is taking a blood sample from a tube with a valve situated on the back of the patient’s wrist. She immediately takes the sample along with paperwork to the room off the ward where the blood/gas analyser is situated. In the room, I observe that she first presses a button near the screen. This action brings the machine out of standby. The nurse swipes her ID card and then inputs details from the patient’s records then she prepares the sample by placing it within an opening port on the analyser. I ask how often she does this, ‘Oh, quite a lot overall on this ward, but it depends on the patient’. She says the test takes about 30 seconds and we wait about for the results. I say, ‘this looks a pretty sophisticated piece of kit?’ ‘Yeah, it’s really important. It’s one of the machines that we rely on a lot’. The device makes a mechanical sound from within that suggests it is carrying out automated steps. In the allotted time or so, the results are delivered in paper for from a slot. The nurse carries out I suspect the usual routine of disposing of the sample. Back at the patient’s bed bay, she is looking at the paper results, which has all the appearance of a till receipt, after some moments of deliberation she exclaims’ yes’ and punches the air with a clenched fist. As I approach to ask her why she might be exhilarated she announces that she had been chasing numbers all morning.*

In the world of ICU nursing numbers are all important. They are, in effect, an interpretive device which nurses use to discern the condition of the patient which may determine additional actions from other nurses and other machines. The implication is that in the network machines have the powers to co-opt and recruit other devices into action, and, not least, they might configure the nurse’s management of the patient. In the following extract from an interview the nurse recognises the meaning of ‘chasing numbers’, she describes the emerging implications for care that might come about as a response to numbers.

*Fn05, female nurse: “So yes when you’re tweaking…obviously one of the things we look at all the time is blood gases to see if the ventilator’s doing what it should do. Do oxygen in the blood to get rid of the carbon dioxide to get the Ph. normal. Because that’s what you need to do, you need to get your Ph. normal. And it’s the same with the filter as well. That’s another couple of numbers you’re looking at on this blood gas. Or you could be giving blood, that’s another…Hb. is on your blood gas, you could be chasing that. These are all numbers that you’re trying to normalise in order to get the patient better. So yes, if you’ve been working all day to do different things, to give them different blood products, different drugs. They’re filtering so you’re filtering all the rubbish out of their blood, and yes if you’ve just done a bronchoscope to clear out their chest and you’ll put a chest rail in to get them to raise their oxygen levels up.”*

Forms of dependency on the technology within ICU were apparent in nurses’ interview accounts. For instance, in order to deliver appropriate care nurses considered the interpretation of the observations from machines to be essential. In this context, where interventions of intensive care are delivered through the application of technology, nurses view the notion of nursing intuition to be redundant. What is all-important in terms of nurse’s perspective is that numbers are part of the quantification of illness; even qualitative presentation of the illness experience, such as indications of pain and its management, require numerical assessment using, for example, sedation scores. What is clear from the next extract is that the nurse respondent has chosen not to rely on direct observation, for, in their view, the complexity of intensive care treatment requires greater accuracy than nurse judgment. In light of the compelling precision of technology in providing up to the minute numeric reports and results of the patients’ condition, the ‘looking-on’ of nurses is reduced to guesswork.

*Mn17, male nurse: “Obviously you can tell when someone is sick and you can make some ball park guesses as to why, but you still couldn't, on this unit, on ICU you couldn't make any quantitative judgments about it. You have to quantify things, how people are getting sick in order to know how to make them better.”*

My analysis suggests that through the pre-occupation with ‘number chasing’ (and ‘looking after organs’ or in the next section ‘balancing technologies’) ICU nurses develop an understanding that leads to a shared meaning that patient’s inner anatomy and related pathologies is occluded from nurses’ ( as humans) embodied senses (Sandelowski, 2000). In the high technology environment of scanners and x-rays, nurses’ observations based on their visual, olfactory and touch senses appear limited in comparison. They are, as the previous extract implies, a mere ‘ball-park’ assessment, a superficial understanding, of the presented illness which are somewhat disengaged from deep anatomical features of bodies with illness. Because the pathologies that nurse meet are obscured from direct observation the ability of ICU technology to penetrate patients’ anatomy, even to the cellular level in the case of blood-gas analysis, ensures that the technologies co-opt, or in other words enroll, nurses into the necessary application of medical devices to patient care. The enrolment of nurses into the technological-nurse network results in a number of performative and sense-making features adopted by nurses.

The interactions of nurses and machines can be analysed, with regard to Law’s (1999) notion of actants (human and non-human), as heterogeneous engineering. All networks, according to Law’s theory, are held together in a set of stable interactions by the work of ascendant elements in the network - with the heterogeneity given in the diversity of the types of actants in the network at any given time.

Actants in this scenario will include machines, protocols, nurses, numbers, organ systems (networks systems themselves), tubing and electronic-digital flows - indeed the difficulty lies in finding and naming all actants that are inside the network. However, it can be presumed that at any moment when a component is in ascendancy in its efforts to form stability through heterogeneous engineering then other actants enrolled at that moment will have ‘proximity’ to the ‘engineer’. Of course, proximity in ANT is not viewed in terms of spatial proximity and the role of classic Euclidian space, of near-ness or far-ness, is exposed in ANT (Law, 1999) as an inadequate explanation of object relationality. For example, within the context of nursing-technology proximity of actants in a network is about influence: a micro-bacteriological test carried out in some other part of the hospital and presented as a series of numbers on a piece of paper can be an influential actant in the stability of the network of objects that operate at the patient’s bedside. Networks are able to fold space, bringing the proximity of influence of particular heterogeneous elements closer to the node point of nurse patient interaction, while other actants close-by remain in the ‘background distance’ as intermediaries with little or no network influence in terms of their transformative relationality to other actants. Latour (1990a) describes this influence of actants at a distance as an absence-presence. In the present space of the patient’s bedside, technology and humans are working with each other:

*“feeling, hearing and touching each other, but they are now talking with many absent things presented all at once. This absence-presence is possible through the two-way connection established by these many contrivances”* (p.7)

In this instance the contrivance is the test report, carried out at a distance but conveyed to the bedside by means of numeric verification displayed on paper. I will say more on the influence of these objects, such as paper reports, monitor graphs, and patients’ records, later when I examine their importance as forms of text to be read by nurses.

A further important aspect of network enrolment is the way that actants who are co-opted may not necessarily engage wholly with the specific purpose of the network. According to ANT the obligation to participate in heterogeneous networks, placed on human and non-human actants alike, is of course a node of power in the network. In enrolment to the network and the empirical node of action nurses may act, in Latourian terms, as either intermediary or mediator (Latour, 2005). The function of the nurse in the network as an ‘intermediary’ is to operate as a fixed ‘black-box’ where the nurses neither add to nor diminish the effects of the technology. In this sense the nurse then cannot be taken that nurses are the absolute and sole agents of patient care within the network. By taking up the ideas and implications of ANT it is equally important to consider who are the actual mediators of care activity; in the micro-bacteriology example presented earlier the test carried out at some distance might be taken as an important mediator of care, whereas the nurse present at the site of care activity may only act as intermediary. The sense of nurse as intermediary is evident in the following extracts where a certain reliance upon the technology is demonstrated; a dependency that suggests a diminishment of mediator power.

*Fn1, female nurse: “Well as you’re going on, you forget about the physical box, that’s what we’re talking about, the information within the technology. So yes you do use that information and the technology in your nursing care because it does in some degree, what’s the word? What information you’ve got from it 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.”*

*Fn14, female nurse: “I’m very reliant [on the technology]. I’ll tell you why. After I had trained in Birmingham, I worked in a cardiac ICU in Birmingham, and then I went to Australia for a year and did ICU nursing as an agency nurse. But one shift I did in A&E, I had a bay of patients. None of them even had a sats probe. They didn't have the oxygen monitor probe. And I was freaking out [laughs loud]... because I didn't know what was going on with the patient. I think I’m very dependent on the technology. because we're so use to them, patients, being hooked up to a monitor that we can...not ignore them in a way, but if anything starts to go wrong, the machines will tell us a lot of the time. It will start to trigger something. 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; whereas, I already found out in that situation that I’m very reliant on the technology to give me a warning sign.”*

On one level the nurses’ accounts demonstrate the determining power of technology on the thoughts and actions of human caregivers, the machines will “start to trigger something”. The assumption is that it prompts nurses towards care activities. In the second extract, the nurse states that she “didn’t know what was going on with the patient”, there is a self-implied notion that whatever knowledge they could bring to bear would not be adequate to deal with the clinical situation. As intermediaries nurses are left consciously divested of activity and meaning: “… *the machines will tell us a lot of the time”*.I would argue that this set of discursive strategies and summations used by nurses in relation to technology is in fact the effects of mediators upon intermediaries within the network. The technology does determine the actions of nurses: it makes them do things, it makes them say things. But the determinacy is an effect of the network, the coming together of all actants makes the alliances and effects within the network contingent and emergent.

It perhaps is understood that in their day-to-day role nurses rely on the stabilisation of networks: that organs are responding, as expected, to drug inputs, filtration or ventilation, and the number chasing has settled to a stable reading of the patient’s status.

*Fn13 female Nurse: “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 all the machines have to be working properly for us to be able to do that. So it's just ensuring that all that is going right as well.”*

This nurse’s statement is in effect the optimal balancing of patient's vital signs with the devices are working correctly and the network of technology providing ‘accurate’ monitoring. At this point ‘number chasing’, as an effect of the technology-organ balancing act, takes a back seat. In this equilibrium, where organs and technology are performing to expectation, nurses perceive the technology as a neutral force in their nursing role. Indeed, it could be suggested that the technology merges into the background of nurses’ activities. At the same time the stability of techno-human network becomes naturalised. That is to say, the whole network acts as a series of empirical facts: numbers become a ‘true’ un-mediated measure of patients’ organs. To borrow a concept from Ihde (1998) ‘visual hermeneutics’ and the task of interpreting observations is displaced by direct inductive knowledge. Acting upon repeated observations and test results informs the inductive ideal of nursing practice, the following extract exemplifies this forceful ICU nursing epistemology when carrying out blood-gases analysis:

*Fn14, female nurse: “So I did another one [blood/gas analysis] and I did it on the other machine and that showed me results more consistent to our previous results… I should have done a best out of three…[S]o I did it again and it was a consistent reading.”*

However ideal this space of network stabilisation is for nurses it is, as ANT suggests, very much prone to displacement and interruption (Law, 2008). For just when dependency on the technology-patient nexus allows settlement, what Callon (Callon, 1986b) describes as *domestication*, the obduracy of certain network actants creates a vertiginous moment for nurses. In the next extract, reproduced here at length, the description has all the appearance of a network breakdown. When the heterogeneous engineering efforts of the nurse to draw together actants: numbers, devices, consultants etc., produces the effect of network stability, the summation of the technological monitoring by the consultant throws the nurse’s practical world into doubt. All that was factual and accurate (for the nurse ‘real’ enough to promote particular practices towards care) are now cast into dramatic disarray as the nurse struggles to re-establish the hitherto stable world created by the network.

*Fn05, female nurse: .So sometimes you feel like you are chasing numbers and things and you think what’s the point because one person is saying, “Yes this is really accurate, we need to be looking at this”. Then the doctors that are here all the time are saying, “Well, actually it’s not really that accurate so can you switch it off.”*

*Interviewer: “So will you think, ‘Why are we chasing the numbers?’ What are your thoughts on that?”*

*Fn05: “I think sometimes every doctor has a different preference about what they want and everyone’s got a different idea of what we should do next…And sometimes you’re a bit clueless. Sometimes you’re a bit like, ‘well this is a bit frustrating because what I am I supposed to be doing here?’ When one person is saying one thing and one’s saying another this number here is raised so you want to do something about it …[S]o that can be a little bit frustrating and you’re kind of unsure of what you’re trying to achieve here because you’re not really listening to what [the technology] is supposed to be telling you in the first place. Why is it there? [the technology] It’s another thing to look at. If it’s not even real then why? It’s another thing that we have to concentrate on when we could be doing other things. Do you see what I mean?”*

*Interviewer: “I do, yes.”*

*Fn05: “So it probably does hinder your patient care sometimes because you’re thinking, ‘Well, is it real?’”*

The uncertainty cast on nurses' technological monitoring and observations by consultants places further doubt on the efficacy of their interventions. At the same time this collision of interpretive purpose of nurses and consultants highlights the strong dependency which nurses place on the empirical loop of technology-human feedback.

As the extract demonstrates, on those occasions when the exigencies of other actants are important the network effects might produce a different ‘reading’: a changed semiotic relationality between machines and nurses, which produces network effects quite different from any notion of technological determinism. This explanation of nurse’s material and semiotic relation towards the technology needs further analysis and clarification. I shall say more about this affair at the end of the chapter when I have presented more findings. However, in the meantime, I wish to move onto explore further effects of the network, which might be construed as technology determining ICU nursing practice.

## Balancing the patient through technology

The task of looking after organs and chasing numbers comes down to one important aspect of ICU nursing which nurses shared as a locally produced metaphor - they are in the business of balancing the patient through the correct control of inputs and out puts. Gathering observations, monitoring patient’s vital organs, creating numbers, looking after organs, upping prescriptions, reducing ventilations are all actions that are directed towards ‘balancing’ the patient with the technology.

*Fn07, female nurse: “Well, quite often we do a lot of struggling with patients' ventilation or numbers that are on those reading. So whether it's something that's on there that's not right, it can feel like you've spent all day trying to fix it and you've adjusted one thing and it doesn't work and then you adjust something else and it doesn't work, so when you eventually find the trick to make it work then it is really satisfying.”*

*Interviewer: “What does that mean, ‘making it work’?"*

*Fn07, female nurse: “Well, to get the numbers into a sort of normal range that you are happy with, that's best for the patient to be in, we are usually aiming for things that keep the patients as stable as possible.”*

ICU nurses’ interaction with technology ‘chasing numbers’ and ‘looking after organs’ become metonymies for patient care. These turns of phrase are in fact ways of understanding the critically ill patient subsumed under the semiotic weight of the network of technological actants. It is in this instance of comprehending the network that the devices - monitors, ventilators gas/ oxygen analysis become mediators - force a particular semiotic ‘reading’ of the patients as these metonymic entities. In fact, it really depends on where and at what time the network is perceived. The notion is, following ANT, that all networks are understood by their local effects.

I am suggesting further that the network and its assemblage of actants configure varied readings of the ICU, and that any reading does depend on the position of other elements in the network - including nurses and devices. From the perspective of the nurse the understanding of the patients is therefore fluid. The nurse concentrates on one particular aspect of their care practice and through doing this alights on a particular instance of the network, which produces a particular reading. Another way of viewing this is to understand the performative nature of socio-technological systems. When the nurse undertakes a particular activity he/she and the devices (and the patient) are engaged in performing that routine, bringing it into being by reproducing relations. *Performancy,* as a strategy, ensures that actant network connections are reinvigorated, but performancy is also a strategy for new effects and dynamic change.

Balancing the patient becomes in other words the effort to set equilibrium between the inputs and outputs. The technology, by its sheer epistemological force (it has more knowledge of the patient than the nurse) profoundly directs the nurse’s perception and interpretation of patient care as a task of organ stabilization. The technology reveals to the nurse the physical and biological sciences of tissue function and in doing so the devices foreground how the patient is to be read by the nurse. The next extract demonstrates how nurses’ pursue this balancing of patients through specific procedural use of outputs (via monitoring) and inputs in terms of drugs.

*Mn03, male nurse: “going back to talking about the LIDCO and the SWAN GANZ [heart monitoring devices], if my patients is venal dilated, because my LIDCO tells me so. I give more noradrenalin. If my patient has got compromised heart contractility I give more adrenalin to drive the heart more. I need to know the deficiencies so I can tailor my therapy. Now, unless you've done some specific monitoring, you wouldn’t’t be able to give those drugs safely. And that is why we monitor our patients more closely so we can give these drugs more safely.”*

This explanation from the nurse concerning balancing the patient is in effect the stabilising of a particular organ - the heart. In actual fact, as the nurse later explained, it is not really feasible to concentrate on one particular body system, in this case the circulatory function. These components, or actants, of the biological network (hearts, lungs, and livers etc.) have real implications for the wider nurse/ machine network. For example, a damaged heart has as much ontological force as a heterogeneous engineer or anything else described in the network. Its requirement for medical attention ensures the enrolment and enactment of a number of other actants in the network.

How so? Well, the heart’s output interfaces with monitoring devices and scanners. The technology in turn translates the biological function into numeric values which are read and interpreted by the nurse; who responds by performing drug infusion as a response to the chase of information. Of course, the story of this network does not stop there; for there are a multitude of other actants that have an absent importance to the stability of this local process of monitoring and treatment. Among those present-absent actants might include pharmacists, medical engineers, pistons, protocols, technical training packs and consultants. This is the nature, as it were, of networks in that they comprise a whole series of heterogeneous agents, human and non-human. In the main most of these actants will have been black-boxed. That is to say, their input to the network would be taken as stable and assured; seldom is the authority of consultants taken to task. This authority over decision-making held by consultants is itself the effect of other networks, demarcated by professional bodies, educational status and social approbation.

Returning to the case of the nurses’ description of balancing the patient, in this example technological actants are engaging with other technologies in a network which includes humans as further actants. The decision over what actant is acting as mediator or intermediary is decided on the localised performancy of the interaction and its effects. The inclination towards technological determination of nurses’ actions lies in the tracing of events to the durable effects of the network. In this instance the nurse’s reliance on monitoring becomes an effect of the actor-network. Monitor technology is therefore both a mediator and heterogeneous engineer. It brings information of the patient’s heart function and shapes it into numeric patterns which condition the nurse to respond as an intermediary. The network enrolled nurse as conduit engages with inputting technology (infusion pumps delivering adrenalin or noradrenalin) to balance out the specifics of the patient’s heart function.

Nurses use the notion of balancing the patient; they also talk about ‘normalising the numbers’. Balancing and normalising are of course two sides on the same coin. To use the ideas of ‘balancing’ indicates that the patient’s physiological status is mediated between input and output technologies. To talk of normalising numbers indicates a prevailing notion of what ‘normal’ is. ‘Normal’ is a further effect of the network. It is powerful enough as a ‘good’ care outcome that networks of humans and non-humans, technology and nurses (and clinical judgment, and monitors and pumps etc.) become engaged in achieving this result. The network will hold together remaining relatively stable for as long as this outcome is obtainable.

*Fn05, female nurse: “So it’s all different things that you’re doing all day and what you want is all these numbers to be normalised. That’s what you’re aiming for at the end of the day. And it is satisfying but it’s also disheartening if you’re trying to do all these things for this patient and they’re not getting any better.”*

This is the semiotic force, the representational power that pervades nurses’ interpretation of the patient: realising the patient as an assembly of organs managed through numeric readouts on the one hand, and interpreting the patient’s condition as the balancing and normalising of those numbers on the other. The indication is that the routinisation of technological vigilance, in an environment where the necessity to adopt these highly sophisticated devices is a matter of life and death, frames the meanings nurses adopt in their understanding of patients and care provision. Put another way, the technological knowledge becomes the prevailing knowledge system used in ICU nursing. At the patient-technology-nurse nexus where the effects of that network produces a corresponding network of ‘semiotic relationality’ (Law, 2009) i.e. ‘balancing’ ‘chasing numbers’ ‘normalising’ and ‘looking after organs’- all semiotic effects of the network inform the discourse of ICU nursing. Consequently they also determine actions towards caring for the patient.

In ANT terms, the shaping of nurses (and of course all other actants) comes about through *translation,* and *enrolment*, which, if successful, shapes the nurse as they enter the network assemblage. *Translation* and *enrolment* in terms of Callon and Law’s (Callon & Law, 1982) perspective are doing the same thing; on entering the network there is a configuring of the actant in line with the purpose of the network, suggesting that the symbolic and material identification of a nurse becomes mutable, changed. If the symbolic notion of a nurse is understood as a relational-effect of potentially multiple networks they happen to be part of then this re-configuration through translation will present a semiological reading of an ICU nurse as carer whose idea of nursing practice is conveyed through technological rationality. Interestingly although the ICU nurses interviewed remained ambivalent as to what nursing care can be, they believe that other nurses who work in the classic Nightingale Style (i.e. hands-on, ‘holistic’ and empathetic) hold them in some suspicion as to their nursing motives and practice around technology.

*Fn09, female nurse: “There’s a lot of misconception about ICU nurses; that at the end of the day they’ve got a nice big chart, they drink lots of tea and just watch the screens and write down numbers all day.”*

The perceptions of ‘ward nurses’ (in the language of the ICU) is that the ICU is populated by technophiles with little regards for humanist notions of care is countenanced by one interviewee’s account of a patient delivered to the ICU. Interpretation would indicate that the ICU nurse is constructing a ‘moral tale’ (Allen, 2001). The rhetorical device works in their account to set a boundary between perceived inadequate care on the general wards and the technologically driven high care standards on the ICU:

*Mn20, male nurse: “…ward nurses bring patients onto the unit. And they want to hand the patient over to one of us. They do seem uncomfortable; out of their comfort zone. On a lot of occasions I do know nurses on here who are to some extent rude to ward staff because when they are handing them over it can be quite apparent sometimes that the care hasn't been particularly good. And there can be bit of an atmosphere between ICU nurses and ward nurse. And I don’t think that that can do our reputation any good.”*

Ensuring translation of all heterogeneous actants is important for the network if it is to remain durable in its effects. Network engineers have strategies which ensure durability over time, not least in ICU nursing where embedding of routinised practice manifest in technological objects ensure the continuity of network relationality (Callon & Latour, 1992). However, keeping networks together is a struggle; they are by and large fragile entities that rely heavily on their continued enactment or performance. It is these enactments from network-actors that both brings the network into existence and reproduce the effects. As Law (2009) indicates, “they hold themselves together but they do so precariously. All it takes is for one translation to fail and the whole web of reality unravels” (p.145).

If, as I am arguing, ICU nursing practices are relational effects of non-human objects (medical devices, technological discourses, nursing values) and human interaction, and that these effects remain durable through continued enactment, but also that they remain delicate entities liable to breaking down, then analysis should bring up the possibility of network crisis. The data does reveal examples where the translation efforts of network-engineers have been unable to stabilise particular actants causing other network-actors to withdraw support for the network. Usually, when this occurs, the effect results in nurses’ diminished reliance on the information the medical device is giving about the patient’s status. The following description from a nurse is perhaps a dramatic example of where a network of nurse and technology relations dissipates.

*Fn13, female nurse: “You can see that they [patients] don't quite look as comfortable as they did before, or their pattern of breathing is not quite the same as it was and you can't put your finger on anything wrong with any of the numbers but you can see that there's something not quite right.”*

*Interviewer: “Can you give me an example about that, a story where that might have happened?”*

*Fn13, female nurse: “Well, I had a patient fairly recently…all his numbers were fine. The blood pressure was fine; everything looked okay. But he had a strange breathing pattern. So he was taking very big breaths, and we couldn't work out why. To look at all the numbers, all the numbers were fine. So we weren't looking and thinking well he's not sedated well enough or he's in pain. There wasn't any indication of those sorts of things, so we sort of tried increasing sedation and tried different settings on the ventilator to try and find what was causing it. And eventually the doctors decided to give a paralysing drug and when they gave this paralysing drug this patient's carbon-dioxide levels shot up because he was controlling his CO2 levels to help reduce this pressure in his head. He was self-regulating. It wasn't until we did that that we realised there was something else going on. The patient went back for another scan of their head, where they found that it was worse than it had been before. It was one of those things where you just knew there was something that wasn't quite right.”*

In this extended extract the nurse’s account reveals that dependency on medical devices to produce an indicator of patient’s condition may have a detrimental outcome.

Earlier in the chapter I pointed to the fact that ‘numbers’ as actors in the technology-human network of ICU nursing have persuasive power as mediators of nurses’ actions. This, I suggested, was because the only way that nurses are able to understand the patient’s illness condition is through micro-biological evidence delivered by technology. Clearly human senses are unable to detect pathology at this level. Thus, nurses, and clinicians, rely on medical technology to offer a window onto the patient’s condition. As such, the authoritative power invested in technology becomes a determining feature of ICU nursing - to some extent at least. That is to say, care is mediated by machines in nurses’ vigilance over numbers as representation of illness. Returning to the extract above, here somehow that web of relations between machines, number production, and nurse interpretation of those numbers has broken down, and the technology has given a false presentation of the patient’s state. As the nurse mentions “*all his numbers were fine”* but the patient was not. I consider situations like this, and there are others in the data, to be vertiginous moment for nurses.

ANT points out that an effect is produced when actants are in accord with the aims of the network. I suggest here that in instances where networks break down, creating vertiginous spaces, effects are also produced from that fracturing. It is as if the nurse has to manage the situation by incorporating new actants, or indeed re-aligning the network with the inclusion of older, more sediment nursing strategies. I am talking about direct patient observation:  *“But he had a strange breathing pattern. So he was taking very big breaths”*. With the use of direct interaction with the patient-nursing observation, clinical management took a new direction, which as a final resort required the patient being sent for scan.

## Hermeneutic devices and nurses’ understanding of patients

I have talked at length on how technology might direct the way nurses understand patients’ conditions. I have said that certain features of patient’s illness are such that the only way nurses are able to understand the condition is through medical technology’s ability to penetrate and reveal the microscopic level of pathology. That, through the necessity of technology, discursive habits have emerged that not only form the meanings that nurse use to represent patients, but also that this world-view (inculcated by technological actants) frames the material relationality between nurses and patients in nurses’ practical action. I wish to conclude this chapter by exploring how this effect (the framing of relations and the construction of discourse of the nurse-technology network) might come about.

The sophisticated forms of care provided in ICU necessitate that nurses enter into epistemic arrangements with the technology they use. By epistemic arrangements I am indicating that the medical technologies used by nurses reveal knowledge of patients’ pathology which would be otherwise occluded from the perceptual affordances of the embodied nurses (Sandelowski, 2000). It is not, however, the case that all illness conditions are beyond nurse and clinician detection. In fact nurses mention that to some extent they may rely on direct nursing observation as a tool for deducing the patient’s illness status. Nevertheless, such is the nature of illness conditions that nurses meet in the ICU environment that there is a heavy reliance on technology outputs of figures and graphs to detect and monitor the micro levels of presenting pathology. In the next interview extract the nurse makes that connection between ‘seeing’ and technology; that the epistemic lens of the medical devices enables a more accurate and less assumptive appraisal of the patient’s physiology.

*Mn17, male nurse: “The technology actually makes you understand the physiology better. So by having the technology there, you can equate what you are seeing in a patient better to your knowledge of how the patient is, and I think that without that [technology] there is a danger of making a lot of assumptions when you are looking at a patient about what is going on inside…”*

The ‘inside’ of the patient is thus obscured from nurses’ normal senses; only by means of the technology can nurses talk about what they are ‘seeing in a patient’. But this ‘seeing’ is of a secondary order, it is knowledge to be sure, however it is mediated by the monitoring technology. In this moment of contemplating the patient technology operates as a ‘hermeneutic device’ (Sandelowski, 2000; Ihde, 1998). The concept of technology as a hermeneutic device draws attention to the fact that seeing patients through technology is an interpretive exercise. By this account the device presents a numeric or graphical representation which is taken as a text. But, being a text representation it is never the ‘real’ phenomena and it therefore has to be ‘read’ hermeneutically by nurses, and translated into yet other text forms by way of patient records.

Reading the patient through technological texts is accomplished within a network of knowledge and understanding - of training and education, of tacit knowledge (Collins, 2001; Polanyi, 1962) gathered from nurse colleagues, senior clinicians and of course from company reps selling medical devices. As a hermeneutic accomplishment the action of reading and interpretation is of course achieved within a techno-human environment that offers a reservoir of textual resources, which is to say, the fact that reading technological texts is achievable, has as much to do with the diffuse technological environment itself. Classic hermeneutics comes to mind when one is directed to the conclusion that we can understand the singular part by examination of the whole; and that the whole (i.e. ICU environment) is understood in relation to the singular hermeneutic accomplishment (i.e. reading/interpreting the technology as text) enacted by the ICU nurse.

Though I am indicating that nurses are in a creative act of interpreting text, I suggest that this interpretation is very much framed by what would be accepted as a meaningful and realistic ‘reading’. What is realistic is indeed framed in part by the ICU context and the exigencies of other forms of technology in the network environment. For in order to maintain the circuit of information from output monitors to input devices such as syringe drivers or ventilation machines, all information that flows has, by necessity, to be meaningful to all actants in the network, both technology and human alike. By this I mean that any attempts to input a 1-litre dose into a 100ml syringe driver is in this sense meaningless to the machine’s technological affordances.

The ICU environment: nurses, patients, monitors, ventilators, patients’ records, beds, domestic staff, and everything else that belongs, make up a circuit of meaningful texts and objects. ANT describes this as material semiotics (Law, 2009) where each component in the ICU network gains its meaning in relation to every other element. On occasion, however, these circuits of meaning can break down. In the following a nurse talks a blood-gases analysis carried out by a supervised student nurse; the nurse reveals that the results were not as expected.

*Fn14, female nurse: “Recently I was looking after a patient and I had a student nurse with me. She took the blood to put it in the machine, and all the readings were completely awful, which was a big change from the one I had done before, and I didn't believe it…[And] we generally go with trends as well.”*

In the account above the circuit of meaning between machine and nurse has somehow been disrupted and the readings from the blood analysis machine are, in the nurse’s own words, ‘not to be believed or trusted’. The nurse takes her queue as to the veracity of the machine’s test output comparing the result against previous results and a follow-up test on another machine. Due to the constant need to monitor patients’ blood-gas balance as a crucial aspect of ongoing patient care the ICU has two blood-gas analysers, placed in rooms at either end of the ward. In this instance the nurse runs a further test on the second machine believing that the first results are meaningless, and she manages the rupture in the circuit of meaning by seeking the ‘trends’ in other elements of the ICU network. It is interesting to note that in order to get to the ‘truth’ of the patient’s blood analysis she then relies on the exact same technology, as the now dysfunctional machine. This is perhaps a rather mundane feature of ICU nursing to point out; nurses would of course be expected to re-test if one machine was not functioning properly. However, what is interesting is that the nurse is striving to maintain trends, to bring back normalcy to the technological network. In this endeavour by nurses as heterogeneous engineers, the term ‘normal’ becomes a stabilising discourse. Normal is a metonymy, a way of talking about machine outputs as a representation of both the patient’s condition and network stability; an understood shorthand for technology and biological components in balance.

*Fn08, female nurse: “You know your ventilator’s working and you know it’s working because the patient’s ventilating; the patient’s breathing. You’ve got rise and fall of the chest; or the numbers that you’re concerned with, are what they should be: the normal values- in inverted commas*.”

This quote exemplifies one of many micro instances of how nurses encapsulate normal states of technology-patient interaction. All components, ventilators, chests, numbers are performing as a stable network. The nurse knows the ventilator is working because the patient is breathing; the patient is breathing because the ventilator is causing a rise and fall of the chest; and the numbers are normal because of the appropriate ventilation. One wonders however, if the experienced nurse perceives it as a set of interrelated moments or whether in everyday practice such clinical situations are apprehended, not as separate instances but, as a picture, as a total representation. This notion might be summed up in the next extract where the nurse talks about the use of technology as second nature:

*Mn20, male nurse: “You get used to all the technology you don't really even think about using it. It’s almost like second nature, knowing how to use it.”*

In relation to the idea of *second nature*, it suggests thatnurses (for the most part) comprehend the ICU environment and their embodied actions within it as a totalising effect. To emphasise this point, later in the conversation the same nurse was asked about taking shortcuts with the technology or working around any problems with the ICU devices. Again, the nurse agrees that they will inevitably take shortcuts, but those instances just meld into the ‘goings on in the world’ of ICU nursing.

*Mn20, male nurse: “I probably take them that often I don’t realize them. Without analysing my day completely I couldn't say anything of the short cuts I take.”*

Thus, the ICU environment consists of networks of heterogeneous elements; each one taking its meaning, understanding and representation from its relationality to all other elements. This is experienced by nurses in any given moment as a localised totality, a gestalt configuration in other words, largely in congress with nurses’ ‘interpretations’ of situations as they manifest from moment to moment. Within the context of nurse-technological interactions, it might be analytically possible to say that the emergence of ICU nurses as accomplished readers of technology and texts is an outcome effect of the techno-human network.

The ability to ‘read’ patients’ physiology through the prism of technology, as I will discuss in the next chapter, is used by nurses to negotiate social interaction with both medical staff and patients’ relatives. However, to close this section I want to finish with the idea that although nurses are competent interpreters of technologically derived information, they are also highly dependent on technology as a hermeneutic device in order to carry out their nursing care role. In this way, the machine’s position becomes clear as an obligatory point of passage (Callon, 1986b). Thus, the critically ill patient needs the treatment deliverable through the ICU technology. Nurses (and of course medical staff) require the technologically mediated observations and test results to deliver that treatment. Nurses’ direct observations of the patient have limited scope; and it is through this ontological limitation that nurses’ observations come to depend on the technology as an obligatory passage point through which to understand and respond to the patient’s illness condition.

As ANT shows, using a Foucauldian discourse perspective (Law, 2009), the language use does more than name these nursing activities. There is a materiality to language which shapes nurses and their care practices: technology determines the ‘world-view’ of nurses both in language and action. Through obligatory dependency on technology nurses enter, in determined ways, into interpreting patients specifically through the illness condition. This is seen in the quote below when the nurse describes her patient in ways that foreground the objective pathology (tackled through technological means) and not the subjective human patient.

*Interviewer: “Does technology determines the way you look at them [patients] in order to ensure the balance of these particular organs. What’s your thoughts on that?”*

*Fn07, female nurse: “But, looking back, we do refer to things like that: renal failure, things like that. We’ll say, ‘What’s wrong with head injury?’ or ‘heart failure’. You don’t say their name but you do tend to talk the condition, yes.”*

Similarly, in the next extract, the nurse’s notion of “knowing” her patient is not about the patient as a social being, but about trends, numbers, and mercury levels.

*Fn09, female nurse: “All these numbers have to be interpreted…It’s knowing the patient. The trends of your patient I think. So you know your patient, you’re rock steady with your blood pressure of 120 over 55-ish, give or take a few millilitres of mercury.”*

The two previous quotes highlight that ICU nurses looking after organs and balancing numbers appear to have a perspective on patients, a world-view, which is enframed by the technological necessity of ICU nursing. I have mentioned earlier, that ICU nurses hold ambivalence towards the role of technology in nursing care. Technological interventions in nursing are not seen as a diminishment of the ideals of what nursing care is. As one nurse rightfully indicated*, “it depends on how you define what nursing is”* [Fn12, female nurse]. Indeed, if technology helps the nurse in their care practice, then ultimately this is viewed as the best possible nursing care on offer. In the next section of the findings I will present and discuss material that indicates that nurses use technology to shape their intersection with other professionals and patients relative. In those scenarios the technology becomes amenable to social shaping, where nurses use its potential social affordances to bolster both their professional identity and caring credentials.

# Chapter Six- Nurses’ use of technology: strategies beyond dependency

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.

## 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. A 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.

## 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 bleeping 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.”*

*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, bleeps, 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 love-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’.

## 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 shows 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.

## 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.

# Chapter Seven- 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.

**Compliant body Resistant body**

**Technological body Social body**

**Time**

Figure 12: 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 bolas 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 bolas 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.

## 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 normality. 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 techno-care 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 it 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.”*

## 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.

## 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.

## 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.

## 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 fornursing. 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, qouted 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.

## 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.

# Chapter Eight- Discussion

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.

## 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 *interessement* 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 it 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.

## Nurses’ social use of technology

In chapter 6, 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 happen 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 minutia 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. Theses 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.

## 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 taken 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.

# 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 can help to address the issues faced by nurses and by extension, patients, their relatives and designers of medical technology.

# References

Akrich, M. (1992). The De-Scription of Technical Objects, in: Bijker, W. E. and Law, J. (Eds.), *Shaping technology, building society*, (pp. 205–224). Massachusetts: MIT Press.

Akrich, M. & Latour, B. (1992). A Summary of a Convenient Vocabulary for the Semiotics of Human and Nonhuman Assemblies, in: Bijker, W. E. and Law, J. (Eds.), *Shaping technology, building society*, (pp. 259–264). Massachusetts: MIT Press.

Alasad, J. (2002). Managing Technology in the Intensive Care Unit: The Nurses’ Experience. *International journal of nursing studies*, 39(4), 407–13.

Allen, D. A. (1997). The Nursing-Medical Boundary: a Negotiated Order? *Sociology of Health & Illness*, 19(4), 498–520.

Allen, D. A. (2001). Narrating Nursing Jurisdiction: “Atrocity Stories” and “Boundary Work.” *Symbolic Interaction*, 24(1), 75–103.

Althusser, L. (1971). Ideology and Ideological State Apparatuses, in: Brewster, B. (Ed.), *Lenin and Philosophy and Other Essays*, (pp. 127–186). New York: Monthly Review Press.

Aronowitz, S. (1988). *Science as Power: Discourse and Ideology in Modern Society*. Minneapolis: University of Minnesota Press.

Atkinson, P. (1988). Ethnomethodology: A Critical Review. *Annual Review of Sociology*, 14(1), 441–465.

Barnard, A. (1997). A Critical Review of the Belief That Technology Is a Neutral Object and Nurses Are Its Master. *Journal of Advanced Nursing*, 26(1), 126–131.

Barnard, A. (1999). Nursing and the Primacy of Technological Progress. *International journal of nursing studies*, 36(6), 435–442.

Barnard, A. (2000). Alteration to Will as an Experience of Technology and Nursing. *Journal of advanced nursing*, 31(5), 1136–1144.

Barnard, A. (2002). Philosophy of Technology and Nursing. *Nursing Philosophy*, 3(1), 15–26.

Barnard, A. (2007). Research and Scholarship for Technology and Nursing, in: Barnard, A. and Locsin, R. (Eds.), *Technology and Nursing*, (pp. 157–172). Hampshire: Palgrave Macmillan.

Barnard, A. & Gerber, R. (1999). Understanding Technology in Contemporary Surgical Nursing: a Phenomenographic Examination. *Nursing inquiry*, 6(3), 157–166.

Barnard, A. & Sandelowski, M. (2001). Technology and Humane Nursing Care: (ir)reconcilable or Invented Difference? *Journal of advanced nursing*, 34(3), 367–75.

Bastos, P. G., Knaus, W. A., Zimmerman, J. E., Magalhães, A., Sun, X. & Wagner, D. P. (1996). The Importance of Technology for Achieving Superior Outcomes from Intensive Care. Brazil APACHE III Study Group. *Intensive care medicine*, 22(7), 664–9.

Benjamin, W. (1999). *The Arcades Project*. Cambridge: Cambridge University Press.

Bingham, N. & Thrift, N. (2000). Some New Instructions for Travellers: The Geography of Bruno Latour and Michel Serres, in: Thrift, N. and Crang, M. (Eds.), *Thinking Space*, (pp. 281–302). London: Routledge.

Blackhall, L. J., Frank, G. & Murphy, S. T. (1999). Ethnicity and Attitudes Towards Life Sustaining Technology. *Social Science & Medicine*, 48(12), 1779–1789.

Blaikie, N. W. H. (1991). A Critique of the Use of Triangulation in Social Research. *Quality & quantity*, 25(2), 115–136.

Bloor, D. (1991). *Knowledge and Social Imagery*. Chicago: University of Chicago Press.

Braverman, H. (1974). *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century*. New York: NYU Press.

Brown, B., Crawford, P., Nerlich, B. & Koteyko, N. (2008). The Habitus of Hygiene: Discourses of Cleanliness and Infection Control in Nursing Work. *Social Science & Medicine*, 67(7), 1047–1055.

Bull, R. & FitzGerald, M. (2006). Nursing in a Technological Environment: Nursing Care in the Operating Room. *International journal of nursing practice*, 12(1), 3–7.

Callon, M. (1986a). The Sociology of an Actor-Network: The Case of the Electric Vehicle, in: Callon, M., Law, J., and Rip, A. (Eds.), *Mapping out the dynamics of science and technology: Sociology of science in the real world*. London: Macmillan Press.

Callon, M. (1986b). Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay, in: Law, J. (Ed.), *Power, action and belief: a new sociology of knowledge?*, (pp. 196–223). London: Routledge.

Callon, M. (1989). Society in the Making, in: Bijker, W. E., Hughes, T. P., and Pinch, T. J. (Eds.), *The Social Construction of Technological Systems*, (pp. 83–103). Massachusetts: MIT Press.

Callon, M. & Latour, B. (1981). Unscrewing the Big Leviathan: How Actors Macrostructure Reality and How Sociologists Help Them to Do So, in: Karin, D., Knorr, C., and Aaron, V. (Eds.), *Advances in Social Theory and Methodology Toward an Integration of Micro and Macro Sociologies*, (pp. 277–303). London: Routledge.

Callon, M. & Latour, B. (1992). Don’t Throw the Baby Out with the Bath School! A Reply to Collins and Yearley, in: Pickering, A. (Ed.), *Science in Practice and Culture*, (pp. 343–368). Chicago & London: The University of Chicago Press.

Callon, M. & Law, J. (1982). On Interests and Their Transformation: Enrolment and Counter-Enrolment. *Social Studies of Science*, 12(4), 615–625.

Carlet, J., Thijs, L. G., Antonelli, M., Cassell, J., Cox, P., Hill, N., et al. (2004). Challenges in End-of-Life Care in the ICU. *Intensive care medicine*, 30(5), 770–784.

Carmel, S. (2003). High Technology Medicine in Practice : The Organisation of Work in Intensive Care.

Carmel, S. (2006a). Boundaries Obscured and Boundaries Reinforced: Incorporation as a Strategy of Occupational Enhancement for Intensive Care. *Sociology of health & illness*, 28(2), 154–177.

Carmel, S. (2006b). Health Care Practices, Professions and Perspectives: a Case Study in Intensive Care. *Social science & medicine*, 62(8), 2079–2090.

Carmel, S. (2013). The Craft of Intensive Care Medicine. *Sociology of health & illness*, 35(5), 731–745.

Centeno, M. A. (1993). The New Leviathan: The Dynamics and Limits of Technocracy. *Theory and Society*, 22(3), 307–335.

Chaboyer, W. P. & Patterson, E. (2001). Australian Hospital Generalist and Critical Care Nurses’ Perceptions of Doctor-Nurse Collaboration. *Nursing & health sciences*, 3(2), 73–79.

Chalkidou, K., Hoy, A. & Littlejohns, P. (2007). Making a Decision to Wait for More Evidence: When the National Institute for Health and Clinical Excellence Recommends a Technology Only in the Context of Research. *Journal of the Royal Society of Medicine*, 100(10), 453–60.

Charmaz, K. & Mitchell, R. G. (1996). The Myth of Silent Authorship: Self, Substance, and Style in Ethnographic Writing. *Symbolic Interaction*, 19(4), 285–302.

Clochesy, J. (1996). *Critical Care Nursing*. Philadelphia: Saunders Co.

Collins, H. M. (2001). Tacit Knowledge, Trust and the Q of Sapphire. *Social studies of science*, 31(1), 71–84.

Collins, H. M. & Pinch, T. J. (1998). *The Golem at Large - What You Should Know About Technology*. Cambridge: Cambridge University Press.

Cooper, M. C. (1993). The Intersection of Technology and Care in the Intensive Care Unit. *Advanced Nursing Science*, 15(3), 23–32.

Crapanzano, V. (1977). On the Writing of Ethnography. *Dialectical Anthropology*, 2(1), 69–73.

Crocker, C. & Timmons, S. (2009). The Role of Technology in Critical Care Nursing. *Journal of Advanced Nursing*, 65(1), 52–61.

Cronqvist, A., Theorell, T., Burns, T. & Lützén, K. (2004). Caring About - Caring For: Moral Obligations and Work Responsibilities in Intensive Care Nursing. *Nursing Ethics*, 11(1), 63–76.

Currie, G. & Brown, A. D. (2003). A Narratological Approach to Understanding Processes of Organizing in a UK Hospital. *Human Relations*, 56(5), 563–586.

Davies, C. (1995). *Gender and the Professional Predicament in Nursing*. Buckinghamshire: Open University Press.

Dean, B. (1998). Reflections on Technology: Increasing the Science but Diminishing the Art of Nursing? *Accident and Emergency Nursing*, 6(4), 200–206.

Dolwick, J. S. (2009). “The Social” and Beyond: Introducing Actor-Network Theory. *Journal of Maritime Archaeology*, 4(1), 21–49.

Donchin, Y. & Seagull, F. J. (2002). The Hostile Environment of the Intensive Care Unit. *Stress: The International Journal on the Biology of Stress*, 8(4), 316–320.

Douglas, M. (1966). *Purity and Danger*. London: Routledge & Kegan Paul.

Dourish, P. (2004). What We Talk About When We Talk About Context. *Personal and ubiquitous computing*, 8(1), 19–30.

Easter, J. G. (2007). Traffic Report. Advice on Improving a Hospital Wayfinding System. *Health Facilities Management*, 20(3), 29–34.

Eden, S. (2011). Food Labels as Boundary Objects. *Public Understanding of Science*, 20(2), 179–194.

Edgley, A., Timmons, S. & Crosbie, B. (2009). Desperately Seeking Sociology: Nursing Student Perceptions of Sociology on Nursing Courses. *Nurse Education Today*, 29(1), 16–23.

Eisner, E. W. (1981). On the Differences Between Scientific and Artistic Approaches to Qualitative Research. *Educational Researcher*, 10(4), 5–9.

Elston, M. A. (1997). Introduction: The Sociology of Medical Science and Technology. *Sociology of Health & Illness*, 19(19B), 1–27.

Epling, M. (2003). An Educational Panopticon? New Technology, Nurse Education and Surveillance. *Nurse Education Today*, 23(6), 412–418.

Estabrooks, C. A. (1989). Touch: a Nursing Strategy in the Intensive Care Unit. *Heart & lung: the journal of critical care*, 18(4), 392–401.

Fairman, J. (1992). Watchful Vigilance: Nursing Care, Technology, and the Development of Intensive Care Units. *Nursing Research*, 41(1), 56.

Featherstone, M. (1998). The Flâneur, the City and Virtual Public Life. *Urban Studies*, 35(5-6), 909–925.

Feenberg, A. (1999). *Questioning Technology*. London: Routledge.

Feenberg, A. (2005). Critical Theory of Technology : An Overview. *Tailoring Bio-technologies*, 1(1), 47–64.

Ferns, T. & Chojnacka, I. (2005). Sinners : Nursing Stereotypes. *British Journal of Nursing*, 14(19), 1028–1033.

Fetterman, D. M. (1998). *Ethnography Step by Step*. London: Sage Publications.

Firestone, W. A. (1987). Meaning in Method: The Rhetoric of Quantitative and Qualitative Research. *Educational Researcher*, 16(7), 16.

Fox, N. J. (2011). Boundary Objects, Social Meanings and the Success of New Technologies. *Sociology*, 45(1), 70–85.

Gadow, S. (1989). Clinical Subjectivity. Advocacy with Silent Patients. *The Nursing clinics of North America*, 24(2), 535–541.

Gesler, W., Bell, M., Curtis, S., Hubbard, P. & Francis, S. (2004). Therapy by Design: Evaluating the UK Hospital Building Program. *Health & Place*, 10(2), 117–28.

Gilmour, J. A. (2006). Hybrid Space: Constituting the Hospital as a Home Space for Patients. *Nursing Inquiry*, 13(1), 16–22.

Glaser, B. G. & Strauss, A. L. (1964). The Social Loss of Dying Patients. *The American Journal of Nursing*, 64(6), 119–121.

Goffman, E. (1970). *Asylums: Essays on the Social Situation of Mental Patients and Other Inmates (Penguin Social Sciences)*. London: Penguin.

Graham, S. (1998). The End of Geography or the Explosion of Place? Conceptualizing Space, Place and Information Technology. *Progress in human geography*, 22(2), 165–185.

Greenhalgh, T. & Stones, R. (2010). Theorising Big IT Programmes in Healthcare: Strong Structuration Theory Meets Actor-Network Theory. *Social science & medicine*, 70(9), 1285–1294.

Grint, K. & Woolgar, S. (2000). The Machine at Work. Technology, Work and Organization. *Organization*, 7(1), 208.

Hadjilambrinos, C. (1998). Technological Regimes: An Analytical Framework for the Evaluation of Technological Systems. *Technology in Society*, 20(2), 179–194.

Hammersley, M. & Atkinson, P. (2003). *Ethnography: Principles in Practice*. London: Routledge.

Hanlon, P. & Carlisle, S. (2009). Is “Modern Culture” Bad for Our Health and Well-Being? *Global health promotion*, 16(4), 27–34.

Haraway, D. (1994). A Manifesto for Cyborgs: Science, Technology, and Socialist Feminism in the 1980s, in: Seidman, S. (Ed.), *The postmodern turn: New perspectives on social theory*, (pp. 82–115). Cambridge: Cambridge University Press.

Harrison, M. I., Koppel, R. & Bar-Lev, S. (2007). Unintended Consequences of Information Technologies in Health Care—An Interactive Sociotechnical Analysis. *Journal of the American Medical Informatics Association : JAMIA*, 14(5), 542–549.

Harvey, F. & Chrisman, N. (1998). Boundary Objects and the Social Construction of GIS Technology. *Environment and Planning - Part A*, 30(9), 1683–1694.

Head, E. (2009). The Ethics and Implications of Paying Participants in Qualitative Research. *International Journal of Social Research Methodology*, 12(4), 335–344.

Heidegger, M. (1962). *Being and Time* (Macquarrie J and Robinson E, Eds.). London: Blackwell.

Heidegger, M. (1975). *The Question Concerning Technology*. New York: Harper & Row Publishers.

Henderson, A. (1994). Power and Knowledge in Nursing Practice: The Contribution of Foucault. *Journal of Advanced Nursing*, 20(5), 935–939.

Henry, S. B. (1995). Informatics: Essential Infrastructure for Quality Assessment and Improvement in Nursing. *Journal of the American Medical Informatics Association : JAMIA*, 2(3), 169–82.

Heskins, F. M. (1997). Exploring Dichotomies of Caring, Gender and Technology in Intensive Care Nursing: a Qualitative Approach. *Intensive & critical care nursing : the official journal of the British Association of Critical Care Nurses*, 13(2), 65–71.

Hess, D. (2001). Ethnography and the Development of Science and Technology Studies, in: Coffey, A., Delamont, S., Lofland, J., Lofland, L., and Hess, D. (Eds.), *handbook of Ethnography*, (pp. 234–245). London: Sage.

Hoerst, B. J. & Fairman, J. (2000). Social and Professional Influences of the Technology of Electronic Fetal Monitoring on Obstetrical Nursing. *Western Journal of Nursing Research*, 22(4), 475–491.

Howarth, G. (2007). *Death And Dying: A Sociological Introduction*. Cambridge: Polity.

Hughes, T. P. (1993). *Networks of Power: Electrification in Western Society, 1880-1930*. Baltimore: The Johns Hopkins University Press.

Hutchby, I. (2001). Technologies, Texts and Affordances. *Sociology*, 35(2), 441–456.

Ihde, D. (1998). *Expanding Hermeneutics: Visualism in Science*. Evanston: Northwestern University Press.

Jensen, R., Meyer, L. & Sternberger, C. (2009). Three Technological Enhancements in Nursing Education: Informatics Instruction, Personal Response Systems, and Human Patient Simulation. *Nurse education in practice*, 9(2), 86–90.

Johnson, N., Cook, D., Giacomini, M. & Willms, D. (2000). Towards a “Good” Death: End-of-Life Narratives Constructed in an Intensive Care Unit. *Culture, medicine and psychiatry*, 24(3), 275–95.

Jones, C. B. & Alexander, J. W. (1993). The Technology of Caring: A Synthesis of Technology Asnd Caring for Nursing Administration. *Nursing Administration Quarterly*, 17(2), 11–20.

Kearns, R. & Barnett, J. (1997). Consumerist Ideology and the Symbolic Landscapes of Private Medicine Levels of Advertising. *Science*, 3(3), 171–180.

Keddy, B., Gillis, M. J., Jacobs, P., Burton, H. & Rogers, M. (1986). The Doctor-Nurse Relationship: An Historical Perspective. *Journal of advanced nursing*, 11(6), 745–53.

Laclau, E. & Mouffe, C. (2001). *Hegemony and Socialist Strategy*. London: Verso.

Lapum, J., Fredericks, S., Beanlands, H., McCay, E., Schwind, J. & Romaniuk, D. (2012). A Cyborg Ontology in Health Care: Traversing into the Liminal Space Between Technology and Person-Centred Practice. *Nursing Philosophy*, 13(4), 276–288.

Latour, B. (1986). Visualisation and Cognition : Drawing Things Together. *Knowledge and society*, 6, 1–40.

Latour, B. (1987). *Science in Action: How to Follow Scientist and Engineers through Society*. Cambridge Massachusetts: Harvard University Press.

Latour, B. (1988). *The Pasteurization of France. Translated by Alan Sheridan and John Law*. Cambridge Massachusetts: Harvard University Press.

Latour, B. (1990). On Actor-Network Theory A Few Clarifications Plus More Than a Few Complications. *Soziale Welt*, 47(4), 369–381.

Latour, B. (1992). Where Are the Missing Masses? The Sociology of a Few Mundane Artifacts, in: Bijker, W. E. and Law, J. (Eds.), *Shaping Technology, Building Society, Studies in sociotechnical change*, (pp. 225–258). Massachusetts: MIT Press.

Latour, B. (1996). On Interobjectivity. *Mind Culture and Activity*, 3(4), 228–245.

Latour, B. (2000). When Things Strike Back: a Possible Contribution of “Science Studies” to the Social Sciences. *British Journal of Sociology*, 51(1), 107–123.

Latour, B. (2005). *Reassembling the Social: An Introduction to Actor-Network-Theory by Bruno Latour*. Oxford: Oxford University Press.

Latour, B. & Woolgar, S. (1986). *Laboratory Life, The Construction of Scientific Facts*. New Jersey: Princeton University Press.

Law, J. (1986). On the Methods of Long-Distance Control: Vessels, Navigation and the Portugese Route to India, in: Law, John (Ed.), *Power Action and Belief A New Sociology of Knowledge*, (pp. 234–263). London: Routledge and Kegan Paul.

Law, J. (1992). Notes on the Theory of the Actor-Network: Ordering, Strategy, and Heterogeneity. *Systemic Practice and Action Research*, 5(4), 379–393.

Law, J. (1999). After ANT: Complexity, Naming and Topology, in: Law, J. and Hassard, J. (Eds.), *Actor network theory and after*, (pp. 1–14). London: Blackwell Publishing.

Law, J. (2008). On Sociology and STS. *The Sociological Review*, 5(2), 623–649.

Law, J. (2009). Actor Network Theory and Material Semiotics, in: Turner, B. S. (Ed.), *The New Blackwell companion to Social Theory*, (pp. 143–158). London: Blackwell Publishing Ltd.

Lehoux, P. (2006). *The Problem of Health Technology: Policy Implications for Modern Health Care Systems*. Oxford: Routledge.

Lehoux, P., Poland, B., Daudelin, G., Holmes, D. & Andrews, G. (2008). Displacement and Emplacement of Health Technology: Making Satellite and Mobile Dialysis Units Closer to Patients? *Science, Technology & Human Values*, 33(3), 364–392.

Lilford, R. J. (2000). Trials and Fast Changing Technologies: The Case for Tracker Studies. *Bmj*, 320(7226), 43–46.

Locsin, R. C. (1989). Technologic Competance as Caring in Critical Care Nursing. *Holistic Nursing Practice*, 12(4), 50–56.

Lorimer, J. (2007). Nonhuman Charisma. *Environment and Planning D: Society and Space*, 25(5), 911–932.

Van Maanen, J. (2011). *Tales of the Field: On Writing Ethnography*. Chicago: University of Chicago Press.

MacKenzie, D. & Wajcman, J. (1999). *The Social Shaping of Technology*. Open University Press.

Macnaughton, R. J. (2007). Art in Hospital Spaces. *International Journal of Cultural Policy*, 13(1), 85–101.

Macnaughton, R. J., Collins, P. J. & White, M. (2009). *Designing for Health : Architecture, Art and Design at the James Cook University Hospital*. Report for NHS Estates, London.

Manias, E. & Street, A. (2001a). Nurse-Doctor Interactions During Critical Care Ward Rounds. *Journal of Clinical Nursing*, 10(4), 442–450.

Manias, E. & Street, A. (2001b). The Interplay of Knowledge and Decision Making Between Nurses and Doctors in Critical Care. *International journal of nursing studies*, 38(2), 129–40.

Marcuse, H. (1964). *One Dimensional Man; Studies in the Ideology of Advanced Industrial Society*. London: Beacon Press.

Marx, K. (1867). *Capital, Volume I*. London: Handsworth: Penguin.

Mason, J. (2002). *Qualitative Researching*. London: Sage.

May, C. (1992a). Individual Care? Power and Subjectivity in Therapeutic Relationships. *Sociology*, 26(4), 589–602.

May, C. (1992b). Nursing Work, Nurses’ Knowledge, and the Subjectification of the Patient. *Sociology of Health and Illness*, 14(4), 472–487.

May, C. & Ellis, N. T. (2001). When Protocols Fail: Technical Evaluation, Biomedical Knowledge, and the Social Production of “Facts” About a Telemedicine Clinic. *Social science medicine*, 53(8), 989–1002.

May, C. & Fleming, C. (1997). The Professional Imagination: Narrative and the Symbolic Boundaries Between Medicine and Nursing. *Journal of advanced nursing*, 25(5), 1094–1100.

May, C., Gask, L., Atkinson, T., Ellis, N., Mair, F. & Esmail, A. (2001). Resisting and Promoting New Technologies in Clinical Practice: The Case of Telepsychiatry. *Social science medicine*, 52(12), 1889–1901.

McConnell, E. A. (1990). The Impact of Machines on the Work of Critical Care Nurses. *Critical Care Nursing Quarterly*, 12(4), 45–52.

McCormick, K. A., Delaney, C. J., Brennan, P. F., Effken, J. A., Kendrick, K., Judy Murphy, J., et al. (2007). Guideposts to the Future—an Agenda for Nursing Informatics. *Journal of the American Medical Informatics Association*, 14(1), 19–24.

Merton, R. (1973). *The Sociology of Science: Theoretical and Empirical Investigations*. Chicago: University of Chicago Press.

Miettinen, R. (1999). The Riddle of Things: Activity Theory and Actor-Network Theory as Approached to Studying Innovations. *Mind Culture and Activity*, 6(3), 170–195.

Miller, J. & Glassner, B. (2004). The Inside and Outside Finding Realites in Interviews, in: Silverman, D. (Ed.), *Qualitative research: theory, method and practice*, (pp. 125–139). London: Sage Publications.

Mitev, N. (2009). In and Out of Actor-Network Theory: a Necessary but Insufficient Journey. *Information Technology People*, 22(1), 9–25.

Moller, D. (1990). *On Death Without Diginity: The Human Impact of Technological Dying*. New York: Baywood Publishing Co.

Mowatt, G., Bower, D. J. & Brebner, J. A. (1997). When and How to Assess Fast-Changing Technologies: a Comparative Study of Medical Applications of Four Generic Technologies. *Health Technology Assessment*, 1(14), i–vi, 1–149.

Murphy, E. (2003). Moving from Theory to Practice in the Design of Web-Based Learning from the Perspective of Constructivism. *The Journal of Interactive Online Learning*, 1(4), 1–13.

Murphy, E. & Dingwall, R. (2007). Informed Consent, Anticipatory Regulation and Ethnographic Practice. *Social Science & Medicine*, 65(11), 2223–34.

Orlikowski, W. J. (1992). The Duality of Technology : Rethinking the Concept of Technology in Organizations. *Technology*, 3(3), 398–427.

Ozbolt, J. G. (1996). Nursing and Technology: A Dialectic. *Holistic Nursing Practice*, 11(1), 1–5.

Peiris, D., Usherwood, T., Weeramanthri, T., Cass, A. & Patel, A. (2011). New Tools for an Old Trade: a Socio-Technical Appraisal of How Electronic Decision Support Is Used by Primary Care Practitioners. *Sociology of health & illness*, 33(7), 1002–18.

Pickering, A. (1992). From Science as Knowledge to Science as Practice, in: Pickering, A. (Ed.), *Science as practice and culture*, (pp. 1–28). Chicago: University of Chicago Press.

Pinch, T. J. & Bijker, W. E. (1984). The Social Construction of Facts and Artefacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other. *Social Studies of Science*, 14(3), 399–441.

Pittet, D. (2001). Compliance with Hand Disinfection and Its Impact on Hospital-Acquired Infections. *Journal of Hospital Infection*, 48(suppl. A), S40–S46.

Poland, B., Lehoux, P., Holmes, D. & Andrews, G. (2005). How Place Matters: Unpacking Technology and Power in Health and Social Care. *Health social care in the community*, 13(2), 170–180.

Polanyi, M. (1962). Tacit Knowing: Its Bearing on Some Problems of Philosophy. *Reviews of Modern Physics*, 34(4), 601–615.

Porter, S. (1991). A Participant Observation Study of Power Relations Between Nurses and Doctors in a General Hospital. *Journal of advanced nursing*, 16(6), 728–735.

Prout, A. (1996). Actor-Network Theory, Technology and Medical Sociology: An Illustrative Analysis of the Metered Dose Inhaler. *Sociology of Health and Illness*, 18(2), 198–219.

Pullon, S. (2008). Competence, Respect and Trust: Key Features of Successful Interprofessional Nurse-Doctor Relationships. *Journal of interprofessional care*, 22(2), 133–147.

Purnell, M. (1998). Who Really Makes the Bed? Uncovering Technologic Dissonance in Nursing. *Holistic Nursing Practice*, 12(4), 12–22.

Rawlings, B. (1989). Coming Clean: The Symbolic Use of Clinical Hygiene in a Hospital Sterilising Unit. *Sociology of Health & Illness*, 11(3), 279–293.

Rnic, S. A., Alapack, R. J., Fridlund, B., Rnan, R. N. & Ekebergh, M. (2008). Beleaguered by Technology : Care in Technologically Intense Environments. *Nursing Philosophy*, 9(1), 55–61.

Romano, C. A. & Heller, B. R. (1990). Nursing Informatics: A Model Curriculum for an Emerging Role. *Nurse educator*, 15(2), 16–19.

Rooke, C., Koskela, L. J. & Tzortzopoulos, P. (2010). Achieving a Lean Wayfinding System in Complex Hospital Environments: Design and through-Life Management, in: *18th Annual Conference of the International Group for Lean Construction*, (pp. 233–242). National Building Research Institute, Technion-Israel Institute of Technology.

Rooke, C., Tzortzopoulos, P., L. J. Koskela, L. J. & J.A Rooke, J. A. (2009). Wayfinding: Embedding Knowledge in Hospital Environments, in: *Improving Healthcare Infrastructures Through Innovation*, (pp. 158–167). London: HaCIRIC, Imperial College Business School.

Rosenberg, A. L. (2002). Recent Innovations in Intensive Care Unit Risk-Prediction Models. *Current Opinion in Critical Care*, 8(4), 321–330.

Saba, V. (2001). Nursing Informatics: Yesterday, Today and Tomorrow. *International Nursing Review*, 48(3), 177–187.

Sandelowski, M. (1997). Exploring the Gender-Technology Relation in Nursing. *Nursing inquiry*, 4(4), 219–28.

Sandelowski, M. (1999). Troubling Distinctions: a Semiotics of the Nursing/technology Relationship. *Nursing Inquiry*, 6(3), 198–207.

Sandelowski, M. (2000). *Devices & Desires: Gender, Technology, and American Nursing*. Chapel Hill: University of North Carolina Press.

Schatzki, T. R. (2001). Introduction: Practice Theory, in: Schatzki, T. R., Knorr Cetina, K., and von Savigny, E. (Eds.), *The Practice Turn in Contemporary Theory*, (pp. 10–23). London: Routledge.

Schaufeli, W. B., Keijsers, G. J. & Reis Miranda, D. (1995). Burnout, Technology Use, and ICU-Performance, in: Sauter, S. L. and Murphy, L. R. (Eds.), *Organizational risk factors for job stress*, (pp. 259–271).

Schoenhofer, S. O. (1989). Affectional Touch in Critical Care Nursing: a Descriptive Study. *Heart & lung: the journal of critical care*, 18(2), 146–154.

Seale, C. (1999). Quality in Qualitative Research. *Qualitative Inquiry*, 5(4), 465–478.

Silverman, D. (1985). *Qualitative Methodology and Sociology: Describing the Social World*. Hampshire: Gower Publications Cp.

Silverman, D. (2004). *Qualitative Research: Theory, Method and Practice*. London: Sage Publications Limited.

Singleton, V. & Michael, M. (1993). Actor-Networks and Ambivalence: General Practitioners in the UK Cervical Screening Programme. *Social Studies of Science*, 23(2), 227–264.

Smedley, A. (2005). The Importance of Informatics Competencies in Nursing: An Australian Perspective. *Computers Informatics Nursing*, 23(2), 106–110.

Sonesson, G. (2007). From the Meaning of Embodiment to the Embodiment of Meaning: A Study in Phenomenological Semiotics, in: Ziemke, T., Zlatev, J., and Frank, R. (Eds.), *Body, Language and Mind. Vol 1. Embodiment.* Berlin: Mouton.

Star, S. L. & Griesemer, J. R. (1989). Institutional Ecology, `Translations’ and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39. *Social Studies of Science*, 19(3), 387–420.

Stein, L. I., Watts, D. T. & Howell, T. (1990). Doctor Nurse Game Revisited. *The New England Journal of Medicine*, 322(8), 546–549.

Suthers, D. (2006). Technology Affordances for Intersubjective Meaning Making: A Research Agenda for CSCL. *The International Journal of Computer-Supported Collaborative Learning*, 1(3), 315–337.

Svensson, R. (1996). The Interplay Between Doctors and Nurses -- a Negotiated Order Perspective. *Sociology of Health and Illness*, 18(3), 379–398.

Taylor, S. E. (1979). Hospital Patient Behavior: Reactance, Helplessness, or Control? *Journal of Social Issues*, 35(1), 156–184.

Teddlie, C. & Yu, F. (2007). Mixed Methods Sampling: A Typology With Examples. *Journal of Mixed Methods Research*, 1(1), 77–100.

The American Nurses Association. (2008). *Nursing Informatics: Scope & Standards of Practice*. American Nurses Association.

Timmermans, S. (1998). Resuscitation Technology in the Emergency Department: Towards a Dignified Death. *Sociology of Health and Illness*, 20(2), 144–167.

Timmermans, S. & Berg, M. (2003). The Practice of Medical Technology. *Sociology of health illness*, 25(3), 97–114.

Timmons, S. (2003). A Failed Panopticon : Surveillance of Nursing Practice via New Technology. *New Technology, Work and Employment*, 18(2), 143–153.

Timmons, S., Crosbie, B. & Harrison-Paul, R. (2010). Displacement of Death in Public Space by Lay People Using the Automated External Defibrillator. *Health & Place*, 16(2), 365–370.

Tjora, A. (2000). The Technological Mediation of the Nursing-Medical Boundary. *Sociology of Health and Illness*, 22(6), 721–741.

Ulucanlar, S., Faulkner, W., Peirce, S. & Elwyn, G. (2013). Technology Identity: The Role of Sociotechnical Representations in the Adoption of Medical Devices. *Social Science & Medicine*, 98(0), 95–105.

Verhulst, O. (2008). Technology in the ICU; the Nurses’ Point of View. *Critical Care*, 12(S2), P528.

Vivian, R. (2006). Truth Telling in Palliative Care Nursing: The Dilemmas of Collusion. *International Journal of Palliative Nursing*, 12(7), 341–348.

Walby, S., Greenwell, J., Mackay, L. & Soothill, K. (1994). *Medicine and Nursing: Professions in a Changing Health Service*. London: Sage Publications.

Walters, A. J. (1995). Technology and the Lifeworld of Critical Care Nursing. *Journal of advanced nursing*, 22, 338–346.

Watson, M. J. (1988). New Dimensions of Human Caring Theory. *Nursing Science Quarterly*, 1(4), 175–181.

Webster, A. (1991). *Science, Technology, and Society: New Directions*. Hampshire: Palgrave.

Webster, A. (2002). Innovative Health Technologies and the Social: Redefining Health, Medicine and the Body. *Current Sociology*, 50(3), 443–457.

Webster, A. (2007). *Health, Technology and Society: a Sociological Critique*. Hampshire: Palgrave Macmillan.

Wilkin, K. & Slevin, E. (2004). The Meaning of Caring to Nurses: An Investigation into the Nature of Caring Work in an Intensive Care Unit. *Journal of clinical nursing*, 13(1), 50–9.

Williams, R. & Edge, D. (1996). The Social Shaping of Technology. *Research Policy*, 25(6), 865–899.

Woolgar, S. (1988). *Science, the Very Idea*. London: Tavistock Publications LTD.

Wynd, C. (2003). Current Factors Contributing to Professionalism in Nursing. *Journal of Professional Nursing*, 19(5), 251–261.

# Appendices

## Appendix A- Letter of invite to participate in interview



|  |  |  |
| --- | --- | --- |
| Brian Crosbie  School of health and Related Research  Regent Court  30 Regents Street  Sheffield  S1 4DA  **Email:** brian.crosbie@sheffield.ac.uk  **Telephone:** +44 (0) 2220884 |  |  |
| 12/04/2010 |  |

Dear Nursing colleague

I am inviting you to participate in a PhD research study, which is being carried out at the School of Health & Related Research- University of Sheffield. The research is looking at ICU nurses’ experience of technology. The study will explore how nurses understand technology and use it in their care practice.

You will have received two information sheets with this letter, which give more detail about the research; including what I am asking nurses do as part of the research. Please take the opportunity to read the information before agreeing. In brief, I would like to interview you once about your experience of technology in nursing, and also make observations of nurses working with technology. If you agree to be interviewed you will receive a £10 record or book token as a ‘thank you’ for your time and participation.

Yours sincerely

Brian Crosbie

PhD Student, ScHARR

## Appendix B- Information sheet for interviewees



Nurses’ views of technology in ICUs

**PARTICIPANT INFORMATION SHEET FOR INTERVIEWS**

You are being invited to take part in a research study, conducted as part of a PhD in the School of Health and Related Research at the University of Sheffield. Before you decide whether to take part it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish.

If there is anything that is not clear or if you would like more information, please contact any of the research personnel involved in this study. Their details are at the bottom of this information sheet. Please take time to decide whether or not you wish to take part.

**What is the purpose of the study?**

The aim of the research is to explore nurses’ views and experiences of different types of technology they use as part of their nursing practice. It is not about making judgements about the kind of care that is given. The research is informed by sociological theory about how people think about and use different technology and what they think technology is. Theory indicates that men and women think differently about technology and this is an area of interest to this study. The research will involve looking only at what you think technology is, what it means to you and how you use it.

**Why have I been asked to take part in the study?**

You have been asked to take part in the study because you are a qualified nurse working in a critical/ intensive care unit, which is an area that utilises a range of different technologies in planning and giving care to patients.

**Do I have to take part?**

No. Involvement in the research is entirely voluntary, and it is up to you to decide whether or not to take part. If you do decide to take part you will be given a copy of this information sheet, two weeks prior to the interview, for your reference. You will be asked to give your written consent before the interview takes place, and will be given a copy of this to keep. You will have the opportunity to ask further questions before the interview starts, and at any point during the study. However, you are still free to withdraw at any time and without giving any reasons.

**What does the study involve?**

This research will be conducted over an eight month period. You will be invited to be individually interviewed once over this period. The research will aim to incorporate interviews with about 10-15 nurses. The interview will take no longer than 1 hour and take place at a mutually convenient time in the vicinity of the Unit on which you work. These interviews will be audio recorded and your words will be transcribed for the purposes of analysing at a later date. The transcription of your interview will not involve any identifying information and will therefore be anonymised.

**What do I have to do?**

You can choose whether or not to be interviewed. If you agree to be interviewed, a mutually convenient time will arranged for the interview. At the interview you will be asked to sign a consent form and invited to ask any questions. The interview will ask for your views on the technology you use as part of your nursing work. For example, you will be asked for your views on the types of technology you use, and how you feel about the role of technological in delivering care to patients. There are no right or wrong answers to these questions they are all about your experiences and views.

**What are the possible disadvantages and risks of taking part?**

It is extremely unlikely that sensitive issues will arise in an interview exploring your views about technology. Therefore, you will never by under any pressure to talk about issues or reveal information about yourself that you prefer to keep private. However, should any sensitive issues arise for you during the interview than further information of personnel whom you can talk to regarding any sensitive information will be given should you require.

**What are the possible benefits of taking part?**

The study is an original research project, and will not have any bearing on your normal activities and your professional relationship with Nottingham NHS Trust. It is hoped that taking part in the research will prove to be an interesting experience. Although it will not benefit you directly, the results of the study will give insight into nursing care with technology in ICUs.

**Will my taking part in the study be kept confidential?**

Yes. All the information about your participation in this study will be kept confidential. Names and other personal information will be removed from the research data and records. Any names used will be anonymised. With your permission, we will make an audio digital recording of the interview so that we can obtain an accurate record of what was said.

Directly quoted extracts from the interviews will only be used if you have given your written consent. Names and other personal information will be removed from these so that it will not be possible to identify the individuals who took part in the study. Non-identifiable data will be retained in a password secured personal computer and laptop within the University of Sheffield. Information you have given will be kept for the duration of the study and for 3 years following completion of the study. The data storage period is in line with University of Sheffield research practice guidelines.

**Where will the research take place?**

Research interviews will normally take place within private meeting rooms and will be conducted within the vicinity of the hospital.

**What will happen if I don’t want to carry on with the study?**

You can withdraw from the study at any time, and without giving any reason. If you do this, you can decide if you are willing for the researcher to use the information and contribution you have already made to the project, or if you want this to be excluded from the study.

**What if there is a problem?**

If you have a concern about any aspect of this study, you should ask to speak with the Principal investigator who will do his best to answer your questions.

**Who to Complain to**

If you have a complaint about your treatment by the researcher or anything to do with the study, you can approach Dr Jennifer Burr at The University of Sheffield (full contact details below).

**What will happen to the results of the research study?**

Information from this study will be used in the completion of a PhD thesis. The results of the study will also be made more widely available through journal publications and conference presentations. Individual participants will not be identified in any report of publication resulting from the study.

The researcher has committed to feeding back the findings from the study to those staff interested. A written summary of the results will be available at the end of the study if you wish and this will be circulated to the Unit.

**Who is organising this study?**

The study is being carried out by a PhD student (Brian Crosbie, details below) based at the School of Health and Related Research, University of Sheffield. The study is funded by the Economic and Social Research Council (ERSC). The research has been through the appropriate research governance and ethical review processes.

**Contacts for further information**

If you have any questions or concerns about taking part in the research, or would like to discuss this further, please contact either of the following:

Dr Jennifer Burr

Lecturer in Sociology of Health and Illness

School of Health and Related Research

University of Sheffield

Regent Court

30 Regent Street

Sheffield

S1 4DA

0114 2220792

2220792  
[j.a.burr@sheffield.ac.uk](mailto:j.a.burr@sheffield.ac.uk)

Brian Crosbie

PhD Student

School of Health and Related Research

University of Sheffield

Regent Court

30 Regent Street

Sheffield

S1 4DA

0114 222 5454

[b.crosbie@sheffield.ac.uk](mailto:b.crosbie@sheffield.ac.uk)

## Appendix C- Information sheet for observations

****

Nurses’ views of technology in ICUs

**PARTICIPANT INFORMATION SHEET FOR OBSERVATIONS**

You are being invited to take part in a research study, conducted as part of a PhD in the School of Health and Related Research at the University of Sheffield. Before you decide whether to take part it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish.

If there is anything that is not clear or if you would like more information, please contact any of the research personnel involved in this study. Their details are at the bottom of this information sheet. Please take time to decide whether or not you wish to take part.

**What is the purpose of the study?**

The aim of the research is to explore nurses’ views and experiences of different types of technology they use as part of their nursing practice. It is not about making judgements about the kind of care that is given. The research is informed by sociological theory about how people think about and use different technology and what they think technology is. Some theory indicates that men and women think differently about technology and this is an area of interest to the study. The research will involve looking at what you think technology is, what it means to you and how you use it.

**Why have I been asked to take part in the study?**

You have been asked to take part in the study because you are a qualified nurse working in a critical/ intensive care unit, which is an area that utilises a range of different technologies in planning and giving care to patients.

**Do I have to take part?**

No. Involvement in the research is entirely voluntary, and it is up to you to decide whether or not to take part. If you do decide to take part you will be given a copy of this information sheet, two weeks prior to the observations starting, for your reference. You will already be aware of the nature of this research through the Nurse Consultant on your unit but the principal investigator will be on your unit and will present an overview of what the study involves, particularly the observations. The observations will take place over a period of eight months, but not continuously. Times will be negotiated according to the demands of unit at any given time. You will be asked to sign an **opt-out** slip (on the bottom of this information sheet) if you do not want to be included in the observations. You will be given the opportunity to ask further questions at any point during the study. You are free to opt out of observations at any time and without giving any reasons.

**What does the study involve?**

This research will be conducted over an eight month period and involves observation research, which is a method often used to gather information about what people are doing over a period of time. It involves the systematic recording of people’s activities, by making notes, in conjunction with interviews (which are also being conducted as part of this study but this information sheet does not provide information about these). During this time the principal investigator will be making observations which may be anything from a few minutes long, for example, observing you change an IV drip, to a more lengthy procedure which might entail the processes of recording cardiac readings. The data he records will be a series of notes about what you are doing with the technology on the Unit. The observations are not about patients, or the care you are giving and Brian will not be making an evaluation of your care practice. He will not observe any activity that involves privacy or contravenes the dignity of patients and will respect any suggestions to stop observing. The processes of observation can be negotiated and over a period of time it is usual that you will be familiar with the presence of the observing researcher. It can feel a little strange to begin with but evidence suggests that the process will quickly become familiar

**What do I have to do?**

Unless you opt-out. The observations will be conducted around you. Observation research requires that you carry on as normal and the presence of the researcher will be as inconspicuous as possible and not involve any direct contact with you and the delivery of patient care. On occasion, the investigator may ask you for clarification- this will not amount to a formal interview.

**What are the possible disadvantages and risks of taking part?**

Being involved in observations can feel strange and make you feel self-conscious about your practice. This is normal. Brian is not a trained nurse, and is not making judgments about your care. The researcher will be available to talk through any issues which you may have found uncomfortable about the observations in private and in confidence. Further information of personnel whom you can talk to regarding any sensitive information will be given should you require it.

**What are the possible benefits of taking part?**

The study is an independent research project, and will not have any bearing on your normal activities and your professional relationship with Nottingham NHS Trust. It is hoped that taking part in the research will prove to be an interesting experience. Although it will not benefit you directly, the results of the study will give insight into nursing care with technology in ICUs.

**Will my taking part in the study be kept confidential?**

Yes. All the information about your participation in observations will be kept confidential. Names and other personal information will be removed from the notes so that it will not be possible to identify the individuals who took part in the study. Non-identifiable data will be retained in a password secured personal computer and laptop within the University of Sheffield. Information you have given will be kept for the duration of the study and for 3 years following. The data storage period is in line with University of Sheffield research practice guidelines.

**Where will the research take place?**

Research observations will take place on the Unit on which you work. To get a full picture of the working day in the Unit, observations will occur at different times during and across shifts.

**What will happen if I don’t want to carry on with the study?**

You can opt out from the observations at any time, and without giving any reason. If you do withdraw the data already collected will be kept and may still be used as part of the research findings.

**What if there is a problem?**

If you have a concern about any aspect of this study, you should ask to speak with the Principal investigator who will do his best to answer your questions.

**Who to Complain to**

If you have a complaint on your treatment by the researcher or anything to do with the study, you can initially approach the lead investigator (Dr Jennifer Burr, full contact details below).

**What will happen to the results of the research study?**

Information from this study will be used in the completion of a PhD thesis. The results of the study will also be made more widely available through potential journal publications and conference presentations. Individual participants will not be identified in any report of publication resulting from the study.

The researcher has committed to feeding back the findings from the study to those staff interested. A written summary of the results will be available at the end of the study if you wish.

**Who is organising this study?**

The study is being carried out by a PhD student (Brian Crosbie, details below) based at the School of Health and Related Research, University of Sheffield. The study is funded by the Economic and Social Research Council (ERSC). The research has been through the appropriate research governance and ethical review processes.

**Contacts for further information**

If you have any questions or concerns about taking part in the research, or would like to discuss this further, please contact either of the following:

Dr Jennifer Burr

Lecturer in Sociology of Health and Illness

School of Health and Related Research

University of Sheffield

Regent Court

30 Regent Street

Sheffield

S1 4DA

0114 2220792

2220792  
[j.a.burr@sheffield.ac.uk](mailto:j.a.burr@sheffield.ac.uk)

Brian Crosbie

PhD Student

School of Health and Related Research

University of Sheffield

Regent Court

30 Regent Street

Sheffield

S1 4DA

0114 222 5454

[b.crosbie@sheffield.ac.uk](mailto:b.crosbie@sheffield.ac.uk)

**OPT-OUT SLIP**

Please read the following statement and sign below.

I have considered the content of this information sheet and I wish to opt-out of any observation research that may take place during my working time in the unit

Name …………………………………………………. Signature………………………………………………..

## Appendix C- Interview Schedule



**Nurses’ understanding and use of technology in the intensive**

**care unit**

Interview Schedule- ICU Nurses

Introduction

Thank you for taking part in this interview. I want to ask you a few questions about your use of the technology within the ICU ward. Please don’t feel there’s a right and wrong answer, I just want to get your understanding of the technology that you use as part of your nursing care.

1. Please tell me about your role in the ICU: (Prompts for further discussion)
   1. How long have you been qualified as a nurse?
   2. How long have you been working in intensive/critical care?
   3. What brought you into nursing?
2. Please tell me about the health technology you use as part of your care routine: (Prompts for further discussion)
   1. Do you find it helps you in your care of patients?
   2. What device/machine do you find particularly useful.
3. What are your views about the technology that you use in your practice: (Prompts for further discussion)
   1. Does it make your work more efficient?
   2. Could you describe an occasion /task where this might apply?
   3. Are there times when it might hinder what you are trying to achieve for the patient?
   4. Can you tell me about an occasion when you felt this way?
4. It is said there is a difference between how men and women view and use technology:

(Prompts for further discussion)

* 1. Do you think men and women have different ideas about technology?
  2. Can you give an example from your nursing experience that highlights this?

1. What are your thoughts on technology in general: (Prompts for further discussion)
   1. Tell me about the sorts of technology in your everyday life?
   2. In What way does it help you to organise your activities?
   3. (Mobile phone, computer)?

1. Permission to use the London Underground map was granted by Pulse Creatives. [↑](#footnote-ref-1)