

Reconceptualising learning  
in student-led improvement  
science projects:

an actor-network theory ethnography  
in medical education

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## **Declaration**

I declare that I have composed this thesis myself and that it embodies the results of my own research. Where appropriate, I have acknowledged the nature and extent of work carried out in collaboration with others included in the thesis.

Signed,

Bethan Mitchell



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## List of acronyms

ABPI	Association of the British Pharmaceutical Industry
ANT	Actor-Network Theory
CHAT	Cultural Historical Activity Theory
PDSA	Plan, Do, Study, Act
ESRC	Economic and Social Research Council
FY	Foundation Year (doctors)
GMC	General Medical Council
GPhC	General Pharmaceutical Council
IHI	Institute of Healthcare Improvement
KIS	King's Improvement Science
NHS	National Health Service
PPS	Point Prevalence Survey
RCP	Royal College of Physicians
SISCC	Scottish Improvement Science Collaborating Centre
SLISP	Student-led Improvement Science Project
SSC	Student Selected Component

# Abstract

The National Health Service<sup>1</sup> in Scotland promotes improvement science methodology as an innovation for implementing rapid change in hospital practices. Student-Led Improvement Science Projects (SLISPs) have been developed as a result of this, where students work with clinical teams to identify, implement and monitor quality improvements in the workplace. Working with improvement science in working practices in a hospital environment presents opportunities for different ways to reconceptualise learning. This research critically examines professionals' learning through practices that are enacted during SLISPs. The focus is on medical and pharmacy students in a hospital setting. The research traces the fine-grained activities, materials, spaces, behaviours and relationships that emerged during a SLISP, with the purpose of gaining a better understanding of what learning means in relation to improvement science. There are recent studies of the educative practices of quality improvement projects in the literature (Armstrong et al. 2015; James et al. 2016) and there are healthcare studies which use sociomaterial approaches (Ahn et al. 2015; Falk et al. 2017; Ibrahim et al. 2015), but this research combines education research, healthcare, improvement science and the sociomaterial approach of actor-network theory. The study described in this thesis draws from ethnographic methods combined with actor-network theory (ANT) to investigate the pedagogies of improvement science. Three ANT dimensions were explored: networks, symmetry and multiple worlds. From the fieldwork data, three 'anecdotes' were constructed: (1) antimicrobial prescribing; (2) insulin recording; and (3) pedagogies of improvement science. Each anecdote was analysed using each of the ANT dimensions. Networks were explored by attuning to relations and associations using the method of 'follow the actor' (Latour 2005). The notion of symmetry provided an alternative perspective of the data by exploring the treatment of humans and non-humans held together in heterogeneous assemblages. Finally, after-ANT concepts were explored through 'multiple worlds' by troubling ambivalences and unfolding practices. Five key insights were presented from this analysis: (1) conceptualising networks presents learning as disruption, as existing networks of practice collide with new networks such as improvement science; (2) materials can invite or exclude practices, leading to learning being shaped materially; (3) invisible or black-boxed activities can become visible through the practices of the SLISP; (4) multiple worlds of practice are manifest in the assemblages of materials which coexist through regulating difference; and (5) professionalism can be conceptualised as an assemblage where learning emerges through practices of ordering. The implications for medical education and education in general are that a broader range of pedagogies exist for improvement science by challenging the conditions of possibility. An ANT methodology contributes to this by noticing details of practice that might otherwise be overlooked and allowing for different enactments of improvement science to co-exist through multiple worlds.

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<sup>1</sup> The National Health Service (NHS) is publicly funded and free at the point of use. There are separate bodies providing care in the NHS in England, Scotland and Wales.





# Chapter 1: Introduction

## **The research assemblage**

*Skin marks the boundary of the patient's body, but paperwork and numbers extend it; parts of the patient (blood, samples) are extracted and sent to labs. Tubes (cannulas, catheters) are inserted into the patient's body, set on metal poles from which the patient can't extricate themselves. Patients are placed in cubicles in bays or in side rooms. They are prone, or move slowly, while practitioners move purposefully around them. They are identified by their pyjamas, their position, their movement (or lack of it). The patient is a network, connected to paper, numbers, plastic and metal, position, time. The patient's body is in the bed all the time, night and day. The staff come and go: this is their work.*

*Paperwork is bounded in files: plastic ring-binders, paper manila folders, or clasped together on a clipboard; attached by holes or pressure; stuck with tape or sticky paper. Marked – inscribed – by pen in different hands: different pen, different styles of writing, text and symbols. The ring-binders are in the bay, the patients' bodies are in the beds. Everything has its place in the ward. The paperwork recording the patient's 'antibiotic story' is messy, full of codes and cues. Protocol is interpreted and weighed up alongside other activities that require different materials, objects, different types of paper. The hidden: lab results, sensitivity and resistance, a plethora of available drugs (some of which have more power than others; the preference to use vancomycin to gentamycin because the latter is considered to be more risky, harmful, fiddly, too many stipulations) with mysterious names. Other treatments that aren't antibiotics confuse the story: painkillers, anti-inflammatories; timings of medicine dispensing, timescales dictated by the gentamycin chart and arrival of lab results. Or – in the middle of the night – is the patient asleep, can they swallow?*

*A sign in the doctor's adjoining room says: "Please return the files to the trolley": the files are picked up and handled frequently, marked inside and out. For the ward round, the trolleys are moved around by the doctors. Staff crowd around some notes – humans and non-humans assembling. Staff crowd around the patient, around the Specialist Registrar like a Higgs Boson, forces pulling. Wait for the telephone to ring with results – creatine levels to prescribe the next dose of gentamycin in the correct timeframe. Foundation Year doctors access particular PCs with the software to calculate doses. They sign the form to instruct the nurse to administer – wait for the nurse to do the rounds: intra-venous or oral? The materiality assembled by this decision impacts on the*

*nurse's work, the patient's comfort (can the patient swallow? Can the nurse find a vein for the cannula?), the rapidity of the antibiotic into the system, levels of toxicity, the chart, the calculation, the written dose, the signature, the notes: part of the patient, part of the network.*

*Networks of relations strengthen or weaken, break and mutate. The diagnosed condition of the patient becomes multiple, a cluster of numbers and names on different pieces of paper, attached in different files and clipped on boards. The patient has a 'history', but it's not clear how far to go back. The history is segmented into files, electronic and paper-based, in different places and on different forms, different handwriting, different concerns. The nurses need to know X, the doctors, Y, sometimes they need to know the same thing for different reasons. The decision for the patient, for their treatment, translated in the power of the inscription of the result, in the experience and command that assembles.*

The above description, a reflective piece that was written after attending an observation, does not directly answer any questions or provide any solutions; it describes a workplace scenario. The approach in this thesis is to attend to the particular, to appreciate and explore, to draw out relations and associations. Describing the entanglements of entities, the way they come together and the effects these produce, draws attention to minute practices and mundane realities that might otherwise be overlooked. In the scenario described, the material and the social are presented equally, with no attempt to ascribe agency or motivation to specific actors. Again, this shifts attention to places and practices that become taken-for-granted, things that slip through the net of research. This thesis argues that, to appreciate the workplace from an education perspective, to trace learning and knowledge as effects produced from interactions in space/time, it is necessary to apply an approach that allows new and challenging descriptions to emerge.

## **1.1 Background to the research**

This research investigates the practices and learning that emerge in healthcare initiatives advanced in the name of 'improvement science'. More specifically, it draws from an education perspective to investigate student-led improvement science projects (SLISPs) in a hospital setting.

Improvement science is becoming part of the discourse of quality improvement in the NHS to promote staff-led, localised improvements, with the rhetoric of creating co-ordinated changes with a standardised approach (The Evidence Centre 2011). The approach incorporates methods such as ‘Plan, Do, Study, Act’ (PDSA) cycles, where a change is tested at different stages. Improvement science has been introduced to meet the needs of both rapid change and evidence-based practice. The National Health Service (NHS) in Scotland has promoted improvement science methodology as an innovation for implementing improvements in hospital practices (The Institute for Healthcare Improvement 2017). Because improvement science has been implemented sporadically, in 2015, a grant of £3.75 million was awarded to set up the Scottish Improvement Science Collaborating Centre (SISCC)<sup>2</sup> to coordinate the practices of improvement science in healthcare, which has encouraged the development of SLISPs. To encourage the take-up of improvement science, medical and pharmacy students in Scotland are being offered the opportunity to lead projects using improvement science methods as part of their training (Buchan et al. 2014; Paterson et al. 2011). The introduction of improvement science into learning programmes requires students to learn a set of strategies and approaches relating to the identification, implementation and management of improvements in the workplace (The Institute for Healthcare Improvement 2015).

My decision to study improvement science projects in medical education was also a result of my own work history. My most recent post was in NHS Health Scotland as a Learning and Development Officer, which I held for six years. While in this post, I had attended a meeting with the Scottish Government on improvement science and potential projects. Improvement science was just starting to become a popular approach in healthcare at the time. Although this was new to me, my background in Management Learning had made me familiar with some of the processes that improvement science draws from, such as: lean methodology; and PDSA cycles of rapid change (The Evidence Centre 2011). My supervisor at the time was appointed as an expert advisor on a newly formed group, the Scottish Improvement Science Collaborating Centre (SISCC) and suggested studying

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<sup>2</sup> <http://www.siscc.dundee.ac.uk/>

improvement science at this stage, as it would be a timely and helpful contribution, and an interesting area to research.

The term ‘Student-led Improvement Science Projects’ (SLISPs) has been created for this study to describe the combination of student project leadership and the application of improvement science methods. As improvement science becomes a dominant approach in quality improvement in healthcare in Scotland, there are questions that need to be raised. For example, is the normative notion of improvement science being critically examined beyond audits and evaluations to challenge underlying assumptions? How is learning configured when carrying out improvement science projects? How do we conceptualise learning for medical students moving beyond individualised learning, and what new insights could this bring to medical education?

### **Current related research**

The literature informing the research described in this thesis is situated at the intersection of two different fields: quality improvement in healthcare and medical education. This relates to improvement science as a co-ordinated national initiative in Scotland, and explores how this has become enacted in SLISPs. This research is situated in workplace learning, practice and professional learning. Current approaches in this field challenge learning as a product or an outcome reflected in the use of terms such as ‘learning outcomes’ and ‘knowledge acquisition’. These terms are potentially restrictive and linked to metaphors that reinforce notions of learning as a ‘thing’ that can be transferred (Boud and Hager 2012). The concept of learning as a collective and material process allows for more emergent, dynamic and creative descriptions (Fenwick and Edwards 2010). In the field of improvement science, learning is presented as product-oriented (an improvement is identified, tested and then implemented), abstract (becomes ‘best-practice’), generalisable (can be applied in different contexts) and causal (change is attributable to the implementation of an improvement). As a consequence, this has led to the development of ‘skills’ in improvement science (Gabbay et al. 2014; Lucas and Nacer 2015) and the promotion of scientific method to measure improvement. However, it is widely acknowledged that it is problematic to apply the same approaches to sociocultural interactions (Greenhalgh et al. 2016). There is a tendency in medical literature to either defer social phenomena to separate studies (Haynes et al. 2009), or to

attempt to combine them (Holden et al. 2013). There are deep ontological assumptions in these approaches, and it is problematic to situate these in the same study.

The education aspect of this thesis encompasses student-led practices in the workplace and connects to professional and practice learning, including sociomaterial conceptions of learning. Current, relevant studies include, but are not restricted to: patient safety and quality improvement in the medical curriculum (Paterson et al. 2011); improvement and medical practices (Allen 2013; Bergs et al. 2015; Cresswell et al. 2010); sociomateriality in the medical curriculum (Ahn et al. 2015; Bleakley et al. 2011; Ibrahim et al. 2015; McMurtry et al. 2016; Zukas and Kilminster 2012); sociomateriality in healthcare (Law and Singleton 2000; Mol 2002); sociomateriality in education research (Fenwick 2014a; Nespor 2014; Sørensen 2009); and sociomateriality in healthcare quality improvement (Dahlgren et al. 2012). The studies are from diverse fields and difficult to navigate in a systematic way. Much of the literature I drew from in my theoretical framing did not have education as a focus but rather came from the broader development of actor-network theory as a social science method (Latour and Porter 1996; Latour and Woolgar 2013; Law and Singleton 2000; Law and Singleton 2003; Mol 2002), and this was something I needed to consider when designing the research. My research was situated in formal education, moving towards professional practice. SLISPs are some way between the two: not 'taught' but based in a live workplace, and led by the student. I therefore concentrated on learning throughout the research, drawing from practice learning (Hager et al. 2012; Landri 2012; Reich and Girdwood 2012), professional learning (Fenwick and Nerland 2014; Fenwick et al. 2014), and medical education (Bleakley et al. 2011; Bleakley 2012; Cleland and Durning 2015).

As well as education and sociological literature, my research also draws from and contributes to research into improvement science itself. A range of research studies in improvement science have been carried out and coordinated through bodies such as The Health Foundation (The Evidence Centre 2011), The Institute of Healthcare Improvement (IHI), Kings Improvement Science (KIS) and the Scottish Improvement Science Collaborating Centre (SISCC). Taxonomic frameworks have been created to produce guidelines from the research (for example, PARIHS (The Evidence Centre 2011)). The consistent application of improvement science methods has been promoted through policy documents (Askew et al. 2015) and course materials (The Institute for Healthcare

Improvement 2017). Research into improvement science has drawn from qualitative and descriptive methods (Bate et al. 2014; Gabbay et al. 2014); for example, complexity theory is an emerging trend in empirical healthcare studies, although approaches in this field have been reported as inconsistent (Thompson et al. 2016). There have also been recent studies in improvement science in clinical education (Armstrong et al. 2015; James et al. 2016) which describe how improvement science is practiced and the impact that it has.

Thus, the research presented in this thesis contributes to a complex network of intersecting research approaches and foci from different fields and disciplines.

### **Context for the research: medical education in Scotland**

Medical education in the NHS in the UK and Scotland is undergoing change towards inter-professional working and collaboration to achieve more ‘patient-centred care’, and values are being reoriented away from the individual and towards the collective (Bleakley 2014). This change, coupled with government demands for more ‘efficient and cost-effective’ work processes (The Evidence Centre 2011), has culminated in the need for clinical staff across disciplines to engage with quality improvement in the workplace, and for consistent approaches to implement change. As Dahlgren and colleagues (2012:186) argue, ‘Quality in health care is ultimately about the patients’ health and life and, it is argued, is dependent on collaboration between different actors in the health-care system, professionals, future professionals, patients and families’. To address these demands, the NHS has adopted improvement methods from other sectors, such as aviation and manufacturing (Worrall 2008). One such measure that has been taken up recently in the NHS is improvement science and, as described earlier, this has been enthusiastically embraced in Scotland. The changing nature of professionalism arising from these measures creates new learning requirements but also new tensions, such as the instability that interrupts consistent and established work practices (Fenwick and Nerland 2014), and unintended consequences which may impact on risk and safety. In addition, the values and ethos of private sector practices such as manufacturing is rooted in profit and turnover, and promotes managerialist approaches which can be at odds with public sector healthcare (Turbitt et al. 2010).

The introduction of improvement science to medical education presents opportunities to explore different pedagogies and to reconfigure learning for students. In the research described in this thesis, the students come from medical and pharmacy backgrounds. In the UK, medicine and pharmacy are two disparate disciplines, accountable to different bodies (Royal College of Physicians (RCP) and General Medical Council (GMC) for medicine; Association of the British Pharmaceutical Industry (ABPI) and General Pharmaceutical Council (GPhC) for pharmacy). The inclusion of different disciplines is relevant to this research because of the growing emphasis on inter-professional practice and learning (Bleakley et al. 2011; Bleakley 2012; Bleakley 2014). For medical students, the standards in *Tomorrow's Doctors* include working and learning in a multi-professional team to improve patient care professionalism. The standards of professionalism also comprise clinical, ethical, legal and moral responsibilities alongside respect, politeness, consideration and trustworthiness (General Medical Council Education Committee 1993). Alongside these developments towards inter-professional and team-based learning is a tradition of individualised working. The Flexner Report of 1910 promoted the 'character' of the 'good doctor', encouraging a particular idea of what doctors should be (Kuper et al. 2013; Whitehead et al. 2013) and has led to the perception of the heroic individual (Bleakley et al. 2011). The transition to more collective ways of working signals a shift in culture, requiring different learning and working methods. Simulation is one such approach that is becoming more widely used in medicine and pharmacy (Ahn et al. 2015; Buchan et al. 2014) as a way of practicing in clinical teams (Bleakley 2014). Medical students also have the opportunity to engage in workplace learning on the hospital ward (Paterson et al. 2011). Workplace learning is considered to be advantageous for medical students by focusing on the integration of practical and emotional learning (Dornan et al. 2009). There is also research which demonstrates the potential advantages of having students present in clinical settings; some report transformative learning for both the experienced healthcare professional and the student (Grant et al. 2010).

In summary, there is a general movement in medical education towards more collaborative ways of learning. Bleakley et al. (2011) argue that this requires taking on theories, such as ANT, which can provide a language of learning other than individual and acquisitional. The SLISPs also require pedagogic approaches that accommodate working in inter-disciplinary groups, with clinical teams and in a clinical setting.



## **1.2 Purpose of the study**

As a discipline, improvement science is in the early stages and much can be learned about how it is enacted through workplace projects. This study is based in Scotland and focuses on how improvement science is being implemented in Scotland. The approaches differ from the rest of the UK by drawing from the IHI Practicum and SISCC rather than KIS and The Health Foundation. ANT has been drawn from in this research to explore how professional learning is enacted during the process of a SLISP; ANT is an approach that encourages a focus on nuance and minutiae. Although evaluations of improvement science projects have begun (Armstrong et al. 2015; James et al. 2016), and ANT is being applied to medical education in medical simulation (Ahn et al. 2015), there has yet to be an exploration of improvement science projects through the lens of ANT. This research addresses this gap and puts forward a new way of investigating improvement science projects in medical education, as well as developing ANT as a methodology. This study problematises the practices and learning that emerge through SLISPs, and challenges the perception of improvement science as a singular entity. This provides broader possibilities for pedagogies of improvement science and offers new ways to conceptualise the position of students as project leaders and agents of change in workplace practice. ANT is particularly suited to this type of investigation, and provides a way of articulating how humans and non-humans assemble to form networks of practices that might otherwise be overlooked (Latour and Woolgar 2013).

### **Significance of the study**

The findings from this research are useful for educators and policy makers to gain a more in-depth understanding of how improvement science is enacted, to inform policy and curriculum decisions. The study is not intended to investigate the effectiveness of improvement science or the changes it brings about to organisations. The research traces the fine-grained activities, materials, spaces, behaviours and relationships that emerged during a SLISP with the purpose of gaining a better understanding of what learning means in relation to improvement science.

This study was funded by the Economic and Social Research Council (2017). One of the requirements of this funding is to demonstrate impact.<sup>3</sup> The ESRC defines research impact in terms of academic, economic and societal, with the contribution of impact being instrumental, conceptual and capacity building. This research contributes to the growing body of empirical evidence in education research drawing from an ANT sensibility, and develops the application of this approach. The setting of the research also contributes to a more in-depth understanding of improvement science and, in particular, SLISPs. The economic and societal impacts of this would be to inform curriculum development in medical education and to influence the policies that surround this. Currently, improvement science and SLISPs are being promoted through government-funded initiatives and collaborations. Investments in this area are required to be appropriately informed by evidence, to which this research will contribute. An emphasis on theory that supports NHS values of patient-centred care, inter-professional working and collaboration will help educators and policy makers to develop more appropriate approaches to education than those that rely on individualism and competition. In this way, my research offers a practice and workplace education perspective to improvement science in medical education.

### **1.3 Research questions**

This research explores learning that emerges as medical and pharmacy students carry out SLISPs. The aim was to trace the fine-grained activities, materials, spaces, behaviours and relationships that emerged during projects, with the purpose of gaining a better understanding of how learning and knowledge emerge as network effects.

There are two main research questions and associated sub-questions. The first question is substantive, relating to learning, and the second is methodological:

1. How is learning configured as students carry out the SLISPs on a hospital ward?
  - How can a sociomaterial lens interrupt individual, acquisitional, cognitive discourses that are prevalent in healthcare to provide new ways of conceptualising learning?

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<sup>3</sup> <http://www.esrc.ac.uk/research/evaluation-and-impact/what-is-impact/>

- How do spatial and temporal arrangements restrict or facilitate possibilities for learning?
  - How can taken-for-granted, mundane, everyday practices that are commonly overlooked be made visible, and what does this contribute to conceptualisations of learning?
2. What do the ANT concepts of networks, symmetry and multiple worlds bring to medical education?
- How do networks assemble?
  - What is the nature of the connections (weak, strong, temporary and so on), and what effects do these produce?
  - What work is holding the network in place?
  - How are educational aims realised or resisted through different assemblages?
  - How do materials invite/exclude or regulate participation in practice?
  - How do different worlds coexist or dominate another in the same practices?
  - What is at stake: i.e., what is sacrificed by making the decision to choose one version over another?

### **Theoretical and methodological framework**

ANT, as a sociomaterial approach, addresses paradigmatic controversies (Lincoln et al. 2011) by challenging the way in which the social and material have come to be separated (Latour 2012). Although my study is not a direct critique or evaluation, ANT enables the scientism of improvement science to be challenged. Part of the motivation for my research and adoption of ANT is that in order to assess learning in SLISPs, it is first necessary to understand the value of that learning and how it is enacted. For example, if SLISPs are contributing to assessment for grading, there needs to be a better understanding of what they *are* through what they *do*; ANT is a method that gives a detailed description of practice and how practice shapes reality and the people that are enrolled in it (Law 2004). The reason for my decision to draw from ANT is because of its fluidity and flexibility, which enables it to be adapted to contexts rather than forcing the cases into predefined methodological boxes. This divergent approach might be termed '*untriangulation*', as Bleakley (2012) positions ANT as the opposite of triangulation. As illustrated in Chapter 9, ANT allows me to trouble the notion of privileging the human, and hence the position of students as change agents. ANT attunes to what is often overlooked (Latour and Woolgar 2013), and to relations; the focus is on what things *do* rather than what things *mean* (Fenwick and Edwards 2010; Latour 2005). Because of this, as will be shown in Chapter 9, my research illustrates how potentially

overlooked factors, such as the colour of a sticker on a form, may be critical in stabilising or destabilising networks of practice and learning. It also shows how decisions that appear to be made about such factors emerge in a process that is distributed over space and time, between actors that include material objects as well as the ones who are nominally 'leading' the improvement. The ANT concept of multiple worlds provides a language to unfold practice and learning, and to trouble the idea of improvement science as a singularity into a multiple.

## **1.4 Structure of the thesis**

This thesis is structured to follow the process of the research. Chapters 2 and 3 outline the literature and studies that were used to inform the research. Chapter 4 outlines the methods used and how the fieldwork was planned and carried out. Chapter 5 introduces the analysis, and Chapters 6, 7 and 8 detail the three ANT dimensions (networks, symmetry and multiple worlds) and how these were applied to analyse the three anecdotes. Chapter 9 draws together five key points from the analysis in terms of learning and SLISPs. Chapter 10 returns to the setting of the research to explore its impact, in terms of the development of an ANT methodology and a detailed study of SLISPs, and possible future studies.

In Chapter 2, improvement science is described through studies, policies and key groups. The background and policy context in Scotland is also discussed. Key terms are defined in relation to the research. The chapter explores concepts such as evidence-based practice, quality, and quality improvement, and what these terms mean to improvement science and SLISPs. Tensions between patient-centred care and return on investment are raised to situate what is meant by 'improvement'. The chapter then describes SLISPs and how these combine improvement science approaches with projects that are led by students. A brief background to the medical and pharmacy curricula are included to describe the different disciplinary trajectories of students. Descriptions of the different professional backgrounds of the students lead on to a discussion about the concepts of inter-disciplinarity and team working in medical education. Professional learning and the practice turn are described, providing the educational context of the study and leading into the theoretical underpinnings of the research. To outline professional learning in the

thesis, three ‘tales’ of learning are introduced, each of which describe different approaches (Mulcahy 2014).

In Chapter 3, sociomateriality is introduced as an umbrella term, under which ANT is situated. The chapter describes the underpinning philosophy of ANT and some of the central concepts that are drawn from in this thesis, specifically: networks as a concept and as a relational approach; symmetry as an approach to describing the relations and effects between human and non-human actors; and multiple worlds as a way of exploring ambiguity, ambivalence and difference. Studies drawing from ANT and situated either in education, healthcare or both, are discussed.

Chapter 4 develops the ANT methodology, drawing from praxiographic (Mol 2002) and ethnographic approaches. The research process and ethics are described here. The cohorts from two different student-led improvement science projects are introduced as two cases: the first cohort’s project comprises a proposed improvement to antimicrobial prescribing procedures; and the second comprises an improvement project for recording insulin. Issues regarding access and ethics and some preliminary meetings and events as part of setting up the fieldwork are outlined. The chapter sets out all the pseudonyms that were given to the participants to protect their anonymity and confidentiality. Both cohorts were working at the same hospital, and their projects were situated in hospital wards. The fieldwork data included written notes from observations, recorded interviews that were fully transcribed, blank medical documents, photographs, reflective notes using Evernote, documents from the SLISPs, and a closed social media site (Slack).

Chapter 5 introduces the analysis strategy and the three ANT dimensions that guided the analysis: networks, symmetry and multiple worlds. Critical questions are introduced for each of the dimensions to sensitise them to each of the dimensions. During the analysis, further annotation of the notes was carried out, following the writing of the anecdotes. Photomontages of these annotations were constructed to further describe the two cohorts and to draw attention to human and non-human hybrids. The method of ‘remove background’ was used on some of the pictures to challenge the conventional boundaries of objects with the purposes of reconceptualising entities as they assemble in practice. Three ‘anecdotes’ are constructed from the fieldwork data which run through each of the analysis chapters: antimicrobial prescribing procedures from Cohort 1, insulin recording

from Cohort 2, and pedagogies of improvement science, which relates to both cohorts. This chapter sets out the analysis and how this was conducted in the three analysis chapters following.

The first analysis chapter, Chapter 6, describes how networks were articulated in the data, first in using the ‘follow the actor’ method (Latour, 2005), and then by using visual methods to attune to relations, forces and effects. The process of noticing an actor (the gentamicin form and the sticker) and then following an actor allowed for the production of descriptions of relations and associations. The visual method of producing diagrams to describe the narrative pathway, as well as annotating fieldnotes and interview transcriptions, guided this part of the analysis. The three anecdotes of the antibiotic story, the sticker and pedagogies of improvement science are explored in terms of the learning effects produced from networks. Of particular interest is how learning emerges from the collision between existing practices (such as antimicrobial prescribing) and introduced practices (such as improvement science). Forces within the network which strengthened connections were also explored, such as the pink colour of the sticker. The early decision of Cohort 2 to adhere to electronic templates was described in this chapter as a way of assembling materials, such as PCs, electricity, devices and the internet, into a network of practice.

In Chapter 7, the same three anecdotes are explored through the dimension of symmetry. This analysis chapter foregrounds the concept of symmetry by attempting to provide equal treatment of human and non-human actants. This approach allows for new ideas to emerge by noticing how practice is materially mediated. The three examples are followed, with Cohort 1 focusing on how paperwork is distributed on the ward; Cohort 2 focusing on how materials shape the practices of insulin prescribing; and the third example explored how the electronic format of the improvement science report affected how the project was carried out.

The third analysis chapter, Chapter 8, draws from the idea of multiple worlds which are inhabited by different practices, and how these worlds co-exist. The analysis of Cohort 1 investigates the recording of ‘duration’ and how this becomes a multiplicity; while that of Cohort 2 explores how clinical space is enacted through conceptualisations of ‘ward’ and ‘floor’; and the third example highlights the conditions of possibility of SLISPs.

Chapter 9 highlights five key points from the analysis which outline some of the main insights of the research. I constructed three anecdotes through the analysis (Adams and Thompson 2016): antimicrobial prescribing, insulin recording, and pedagogies of improvement science. I applied each of the ANT dimensions of networks, symmetry, and multiple worlds to the anecdotes in Chapters 6, 7, and 8, respectively. From this process, I identified five key points which form the argument advanced in this thesis:

1. Learning can be conceptualised as a network effect. In other words, learning is not restricted to the individual but can be thought of in terms of space/time. Networks can strengthen, stabilise, and mutate. New networks (such as those formed by SLISPs) interact with existing networks, creating effects of destabilisation, change and learning.
2. Material configurations, such as paperwork, stationery, furniture and so on, shape practice and learning. Humans and non-humans assemble into networks and create effects. By focusing on the effects and not the entities themselves, it is possible to conceptualise a situation without privileging the human. In so doing, new insights are brought into focus.
3. SLISPs can enable participants to *un-black-box* practices by noticing activities that have become taken for granted. Learning emerges as a consequence of changing a 'matter of fact' into a 'matter of concern' (Latour 2005). In other words, sets of activities can be made visible, such as mundane practices, including gaining access through a door or using a buzzer to contact a staff member.
4. It is possible for learning to emerge through ambiguity and confusion as this can indicate multiple meanings in different worlds. In other words, doubts about something which is presented as a singularity (for example, a SLISP) can signpost to something more complex. Different versions can co-exist through regulating difference. For example, multiple meanings can be brought together and narrated as a singularity, as improvement science has been narrated through various groups. Alternatively, multiple worlds can exist in incommensurable realities that either co-exist or compete until one is taken over by the other.
5. Ordering and assembling of heterogeneous entities can lead to new notions of professionalism. For inter-disciplinary working, team working and

collaborative working, new assemblages create new conditions of possibility. In terms of improvement science, new ways of working can challenge membership of professional groups, leading to new groupings and possibilities.

The final chapter, Chapter 10, reflects on the methodology of ANT and highlights some of the insights gained during this process. There are implications for medical education and education in general. The implications are that a broader range of pedagogies exist for improvement science by challenging the conditions of possibility. An ANT methodology contributes to this by noticing details of practice that might otherwise be overlooked and allowing for different enactments of improvement science to co-exist through multiple worlds. ANT also provides a language with which learning and knowledge can be conceptualised: as network effects in space-time; through shaping practice in assembling heterogeneous entities; and through the interaction of different worlds of practice that either coexist or compete to enact realities in the workplace.

*My personal motivation for carrying out this research is rooted in my past work experience. As someone who started working 30 years ago and who has moved through numerous different workspaces, from quarries to leisure parks, from hospitals to manufacturing plants, I developed an appreciation of the materialities and relativity of practice. When I embarked on a career in education 15 years ago, I was already thinking about the artificial juxtaposition of formal learning and workplace practices. However, until now I never had cause to articulate this and to explore the meaning of learning in the workplace as sociomaterial. During my Master's in Management Learning and Leadership, I conducted research and started to explore post-modern language through feminism, and poststructuralism through Foucault. This was new to me at the time, and I struggled to understand the intricate terms and underlying philosophy. However, I was drawn to poststructuralism and actor-network theory (ANT), as these aligned with my own perceptions: ANT made sense in the context of my own experience in the workplace.*

*Now I am writing about my doctoral research, about how I studied students carrying out quality improvement projects. But how can I do this from an ANT perspective? How can I claim to move away from individualism and the 'heroic actor' when I have students as the focus for my study? These questions persisted as I moved through collecting data*



*through the fieldwork and then onto the analysis. To describe this in ANT terms, I was between different worlds of practice that 'hang together', allowing the work to continue without the requirement of reconciliation. The one world was the student, their grades, assessment, performance, written reports. The other world was the relations between humans and non-humans, and the messiness of workplace practice. There was not a linear progression from the individual to the collective-community to the assemblage. There were oscillations, fluctuations, fluidity and uncertainty. I cannot claim to have come to an end with this exploration, but I have instead created an uneasy pause made necessary for writing my thesis.*



## Chapter 2: Improvement Science and the Medical Curriculum

## **2.1 Introduction**

This study explores learning in improvement science and how this has been implemented in medical education through Student-Led Improvement Science Projects (SLISPs). Combining improvement science and the idea of students as change agents, SLISPs provide a framework for students to lead workplace projects. The research focus is on professional and workplace learning, undertaken as part of formal training for pre-service doctors and pharmacists. This chapter describes the setting and orientation of this research within quality improvement in healthcare and professional education.

This research explores the detailed practices of SLISPs with the purpose of understanding how learning emerges as students carry out these projects. In order to describe how these practices have come about, it is necessary to explain some of the historical and political aspects of improvement science and how these led to SLISPs. The chapter begins by introducing improvement science as a systematic approach to quality improvement, and describes how it has been introduced to healthcare against a backdrop of service integration, public accountability, and a reliance on evidence-based practice. Improvement science is introduced in terms of quality improvement methodologies in healthcare, and then described alongside other approaches. The main political and coordinating bodies that influence the development of improvement science are described, along with political drivers for the approach in Scotland. The argument progresses by describing how improvement science has had an impact on the requirement for healthcare staff to work inter-professionally and collectively, and the development of a curriculum that promotes these ways of working. The chapter goes on to situate the research in professional and practice learning by describing the historical trajectories in these fields. The chapter then brings together professional and practice education with SLISPs in the context of medical education to draw attention to the tensions between individualised and collective approaches to learning.

### **Key terms**

There are a range of different terms that are used in conjunction with improvement science, and these are associated with the organisations, concepts, historical trajectories and studies to date that have led to the enactment of SLISPs. Some of the overarching terms encountered in the research are: quality, improvement, quality improvement,

improvement science, safety, and patient safety. Although the words and phrases are similar and overlapping, there are differences and juxtapositions that need to be expanded on in relation to this research. In healthcare, *quality* is defined as safe, effective, person-centred, timely, efficient and equitable. *Quality improvement*, as defined by the Health Foundation, is:

a systematic approach that uses a defined method to improve quality, with regard to better patient experience and outcomes achieved through changing the behaviour and organisation of healthcare providers. (Gabbay et al. 2014:2)

*Improvement science*, in relation to the above definition, refers to a ‘systematic approach’ and ‘defined method’ to improvement that provides credence and validity to an improvement. *Improvement* in healthcare relates to *patient safety*, in that the patient experience is widely considered to be the most important aspect (Dahlgren et al. 2012). However, patient safety is related to many different factors, such as medical error, communication and collaboration (Bleakley 2014); other arguments, such as economic and organisational improvement, are also important contributors to patient safety. These descriptions illustrate how terms overlap, repeat, join and form different meanings from different combinations. It also shows how terms can be close but not synonymous. For example, improvement science is a way to implement quality improvement, but quality improvement does not have to employ improvement science methods. Similarly, quality measurement can refer to auditing and monitoring, whereas quality improvement is about implementing change. In the context of this research, improvement science relates to an approach to quality improvement which involves implementing and monitoring a change in the workplace over a short period of time (four to six weeks for a short project, but sometimes longer). In this study, there is an emphasis on the approaches, methods and tools promoted by the Institute for Healthcare Improvement’s Open School Practicum (The Institute for Healthcare Improvement 2017). The term ‘improvement science’ is not always used explicitly in the healthcare quality improvement literature, and other terms such as the Model for Improvement, which includes the Plan, Do, Study, Act (PDSA) cycle, are referred to when discussing improvement (Langley et al. 2009). These terms are explained in more detail in the following sections.

## **2.2 Tensions in quality improvement: finance and the patient**

Quality improvement in healthcare in Scotland is a high priority. NHS Scotland's investment in quality measures has led to international recognition and praise from the Institute of Healthcare Improvement (IHI), heralding Scotland as the 'first health service in the world to adopt a national approach to improving patient safety' (The Institute for Healthcare Improvement 2017).

This investment in improvement in Scotland is driven by policies such as the Scottish Patient Safety Programme (SPSP) (Healthcare Improvement Scotland (HIS) and SPSP 2009) and the NHS Quality Strategy (The Scottish Government 2010). The SPSP is a strategy for staff to lead on improvements in the workplace and is based on the United States' Breakthrough Series which guides staff through the identification, implementation and evaluation of improvement projects (HIS and SPSP 2009); it is also based on the Model for Improvement, which incorporates the PDSA cycle (Langley et al. 2009). Other strategies include the outcomes-focused approach within the NHS in Scotland which is driven by the 2007 Scottish Government Spending Review and the Health, Efficiency, Access and Treatment (HEAT) targets and standards (The Scottish Government 2016). The Scottish Government demands accountability and regular reporting from health boards in Scotland through HEAT targets (now Local Delivery Plans) and other policy drivers. However, the direction of accountability and authority in policy making is not always top-down. Policy drivers and activities often lead to the formation of specialist groups which then in turn lobby particular policy decisions. For example, the Scottish Antimicrobial Prescribing Group (SAPG) was set up by clinical experts to address antimicrobial stewardship, hospital acquired infections (HAI) and increasing antibiotic resistance. The SAPG advised the Scottish Government and collaborated in the resultant HEAT target for HAIs (Scottish Medicines Consortium 2017). This illustrates how government policy takes on the advice of experts and recommendations for improvement. Concerns centring on patient safety are also balanced with economic capacity, which can lead to tensions in policy development. Traditionally, quality models in the NHS drew from an assessment of benefits, risks and costs (Donabedian 1980), and the NHS has been encouraged to become more 'business-like' since the Griffiths Report of 1983 (Ham 2004). In Scotland, the Christie Commission was called to review spending in public bodies and improve the efficiency

of services (Rowe and Chapman 2015). There is now greater emphasis on targets and Return on Investment (ROI) measures (Ham 2004). The policy landscape, with policies emphasising patient care balanced with economic factors, illustrates the tensions in conducting quality improvement. Moreover, research on quality improvement in healthcare has been criticised for its inconsistency. For example, Alexander and Hearld (2009) state that this type of research is difficult to synthesise because of differences in research methods and approaches. They contend that many studies omit cost/benefit or ROI considerations, and this makes it difficult for managers to use and implement findings in the context of budgets and cost efficiencies. Some studies have addressed this issue, using ROI as a measure so that managers can make a case for budget allocation and expenditure (Davey et al. 2013). Another criticism levelled at quality improvement research is the length of time it takes, on average, for evidence to be put into action; this has been cited in recent studies as being seventeen years (The Health Foundation 2011). The length of time impacts on patient treatment, and some studies point out that it is unethical to stall change in order to wait for evidence to become available (Tannahill 2008). The demand for accountability, reporting and responsiveness has led to interest in a broader range of quality improvement approaches, particularly those that promote rapid change.

Consequently, the NHS in the UK has been proactive in the search for alternative and faster approaches to quality, adopting methods from other industries outside healthcare, such as aviation and manufacturing (Aherne and Whelton 2010). For example, the 'surgical safety checklist', a pre-operative surgical practice centred around a set of key questions to prevent surgical errors such as wrong-site surgery developed by the World Health Organisation (WHO), has been adapted from the checklists used in aviation (Worrall 2008). Another approach that has been enthusiastically taken up is 'lean' thinking, a performance management approach which involves making small changes in all parts of the organisation to improve processes and eliminate waste. Originally applied in manufacturing industries in Japan, lean thinking has been linked to innovations in processes through the close scrutiny of workplace practices. Some authors consider the lean approach to have been successful in healthcare (Aherne and Whelton 2010), whilst others are more sceptical of adopting approaches which may be considered faddish and insubstantial (McCann et al. 2015). PDSA cycles and statistical controls, adapted from lean, are used in many of the models and studies in quality improvement (Peden and

Rooney 2009). Although there have been studies demonstrating how lean thinking has improved organisational processes in health settings, the differences that exist between manufacturing and healthcare create problems of translation (Powell et al. 2009). Turbitt et al. (2010) contend, drawing from Moore's theory of Creating Public Value, that differences in public sector organisations (such as the NHS) and private sector operations occur at service level. For example, NHS managers are required to propose value that is beneficial for the public, rather than for private individuals, organisations and shareholders; this is referred to as 'public value propositions'. These propositions require approval from public sector bodies, public forums, the media, tax payers and interest groups in order to become operationalised. More broadly speaking, the public sector needs to consider social, as well as economic, factors. There are other factors in the public sector, such as equality of access to services, that are not relevant in the private sector (Rowe and Chapman 2015), and these differences need to be taken into account as public sector bodies such as the NHS take up approaches from the private sector.

In addition to these differences at service level, there are also problems with researching the effectiveness of interventions in healthcare. The surgical safety checklist is a good example of how the pressures of publishing research has influenced the type of studies produced, as much of the literature in this field comes from quantitative, pre- and post-intervention studies that do not account for the social aspects of checklist practices. The surgical safety checklist was cited as an example in an open letter to *The British Medical Journal (BMJ)* (Greenhalgh et al. 2016), where a large number of academics argued for more inclusivity in medical journals of qualitative studies, as it was widely recognised that quantitative, replication studies did not take into account the complex sociocultural interactions that are pivotal to medical interventions. Many quality improvement studies are not published, and this has led for calls to make quality improvement work more transparent (Davidoff and Batalden 2005).

There are other models employed in healthcare to address the needs of quality improvement that are worthy of note at this stage. These approaches are not necessarily an alternative to improvement science, and can be introduced as a way of understanding broader issues of quality improvement alongside SLISPs. Systems Engineering Initiative for Patient Safety, or what is now referred to as SEIPS 2.0, is a human factors framework for improvement. Human factors, or ergonomics, refers to the functional design of



systems and the interaction between humans and equipment. SEIPS 2.0 considers human factors, tasks, technology, organization, and the internal and external environment (Holden et al. 2013). The SEIPS 2.0 model is an example of systematic, evidence-based approaches to healthcare processes and improvements that focus on systems. Systems thinking, through complexity and complex adaptive systems, is also being increasingly drawn on in healthcare studies (Thompson et al. 2016). The systems approach provides a way of studying micro and macro processes to identify possible quality improvement measures. Models and approaches such as lean, SEIPS and improvement science have become increasingly popular in the healthcare sector as a way of legitimising improvement measures. One of the reasons for this is to ensure practices in the healthcare sector are based on evidence.

### **2.3 Evidence-based practice: is it worth the wait?**

A long tradition of accountability and state authority in the public sector has created an expectation in healthcare that quality and quality improvement draw from relevant and current evidence. Evidence-based practice (EBP) refers to a rigorous process where changes and improvements are supported by scientific evidence. In healthcare, different types of evidence are ranked hierarchically according to levels of rigour, validity and credence (McKimm et al. 2017). Randomised Control Trials (RCTs) are considered to be the ‘gold standard’ of the evidence hierarchy. RCTs are typically large-scale experiments in which a randomised group of patients receive a particular form of treatment. Despite its prominent status, there are several problems associated with the RCT method, and it is acknowledged in the field that it is not appropriate for all interventions to be measured in this way (Bhattacharyya et al. 2009; Damschroder et al. 2009). For example, as mentioned earlier in this chapter, the delay in putting evidence into practice created by the requirement for evidence could stall important treatments or interventions that are given to patients, leading to ethical concerns (Tannahill 2008). This is particularly pertinent when assessing quality improvement measures which may include improvements to processes, work practices and complex sociocultural interactions. Whilst RCTs might be a reliable indicator for drug trials, education and social interventions are not an appropriate fit. In many cases it would be more appropriate for research in medical education and quality improvement in patient care to draw from qualitative approaches which seek to appreciate and investigate rather than explain and

predict (Bleakley 2012). As mentioned previously, recent research has encouraged new approaches such as complexity theory and ecological models to investigate healthcare interventions (May et al. 2016; Thompson et al. 2016).

### **Improvement science: from gold standard to silver bullet**

Improvement science has been described as a gap between research (what is possible) and audit (what is actual) (The Evidence Centre 2011), where research is exploratory and introduces new interventions, and audit is described as measuring against a standard (Lindsay 2007). Improvement science has been adopted in the NHS as a way of coordinating quality improvement and the implementation of improvements in a more structured way. There are two central ideas to improvement science: (i) that an improvement is implemented and tested over time, and (ii) that improvements are identified by experts in the field (Rowe and Chapman 2015). The Health Foundation defines improvement science as:

the application of a range of basic and applied sciences, delivered through a partnership of researchers and those who work in and use health services, with the aim of creating new knowledge and promoting strategies for the implementation of evidence-based healthcare, leading to improved processes and improved health outcomes for patients and populations. (The Health Foundation 2011:2)

The above quote illustrates the expectation that interventions are informed by evidence, aligned with the values of evidence-based practice (EBP). Improvement science has also been described as the exchange and synthesis of knowledge to improve services (Bhattacharyya et al. 2009), and ‘a body of knowledge that describes how to improve safely and consistently’ (The Evidence Centre 2011:6). Increasingly discourses of ‘what works’, which describe how existing evidence is used in public services including quality improvement measures such as improvement science, are being proliferated in the health service as a response to the protracted time that is taken to put evidence into action and the paucity of available research needed to make decisions (Rowe and Chapman 2015).

For SLISPs, a range of online templates are provided by the IHI: cause and effect or fishbone diagrams for identifying different aspects of the proposed improvement; process

diagram templates for mapping process trajectories; run charts for plotting data as the improvement is tested; and Plan, Do, Study, Act (PDSA) cycles for recording different stages of the improvement process (Appendix 3, Figure 2.1). Improvement science also encompasses the idea of balancing measures to explore intended and unintended consequences. For example, improvements to the use of prophylactic antibiotics to prevent Hospital Acquired Infections must also be balanced against antimicrobial stewardship to prevent the over-prescription of antibiotics leading to resistance (Scottish Medicines Consortium 2017).



Figure 2.1: Model for improvement, from <https://www.hrsa.gov/quality/toolbox/methodology/testingforimprovement/part2.html>

Numerous bodies and groups have been drawing together strands of improvement science and assessing how this is translated into practice. The Institute for Healthcare Improvement (IHI) is an international collaboration for improvement science. The Health Foundation, a UK charity, has been building a resource base through systematic reviews, frameworks and empirical research in the field. King's Health Partners, also UK-based, are involved in defining what improvement science means in the UK by setting up a team of improvement scientists, forming King's Improvement Science (KIS). The Scottish NHS Special Health Board, Healthcare Improvement Scotland (HIS), has

set up a Quality Hub in collaboration with other NHS quality boards and coordinates improvement activities across Scotland. The favoured approaches in quality improvement in Scotland differ from the rest of the UK (Rowe and Chapman 2015), as Scotland is driven by different policy directives and quality improvement approaches.

As discussed previously, there are different perspectives regarding what constitutes an improvement. For example, improvement for clinicians is more likely to be based on health outcomes; for patients, the effectiveness and delivery of services is most important; and for managers, the costs and benefits must also be considered (Gillam and Siriwardena 2014). This means that there is no standard set of criteria for ‘improvement’, but there are elements that are desirable to achieve, such as quality, efficiency, equity and value (Rowe and Chapman 2015). In terms of patient care, systems and procedures can be complex, and this can affect what might constitute an improvement. In healthcare practices, patients often present with more than one condition, and require treatment on more than one ward with different specialists and medications. This affects the paperwork practices, patient records, and the movement of information within and outside wards. In terms of quality improvement, with numerous and overlapping practices being carried out simultaneously, what might be considered an improvement in one area might be contested in another. There is also the issue of consistency in practice to prevent errors and allow for professional judgement, rather than relying on a rigid protocol.

Improvements can address medical errors and streamline systems. There is a growing body of literature in the field of healthcare systems with the introduction of electronic and technological advances (Berg and Goorman 1999; Cresswell et al. 2010). There are studies which describe how changes to paperwork procedures affect work on the wards, such as Allen’s (2013) description of the Integrated Care Pathway, which was introduced to the ward as a single form that incorporated many other forms. The main finding of the research was that some staff found the form very helpful, but others found the form restrictive and preferred the original, multiple forms. Berg and Goorman (1999) also warned about the dangers of abstracting information that is contingent on practice, and the risks of information becoming misinterpreted and out of context. These examples illustrate the impact of mundane practices, and the necessity to explore processes in detail, particularly when considering an improvement or change. The examples also

illustrate the potential instability created by an innovation, such as improvement science, balanced against the need for consistency in practice (Fenwick and Nerland 2014). It is within this delicate balance that improvement science and SLISPs are conducted.

## **2.4 Students as agents of change**

The term ‘SLISPs’, has been created for this research rather than being an official or adopted term from the host university. This term refers to two important factors: (i) that the projects are led by students who are considered ‘change agents’ for improvement; and (ii) that the project follows improvement science methods. The host university terms the projects ‘Student Selected Components’ (SSC), which are identified in the medical curriculum as short projects which the students elect to take; however, this term also refers to other projects, such as work shadowing. SLISPs are guided by the IHI Open School templates and completed projects are posted onto the IHI site (The Institute for Healthcare Improvement 2017). Some projects are also submitted to *BMJ Quality Improvement Reports* (Okwemba and Copeland 2014). In some universities in Scotland, improvement science has been introduced to the curriculum either as a mandatory or selected component (University of Stirling, Department of Health Sciences 2015), as the focus of short, student-led projects. In pharmacology, students have been encouraged to participate as ‘partners’ in the development of the pharmacy curriculum. In a pharmacy study situated in Scotland, this led to the improvement of the curriculum, where students highlighted that there was too much emphasis on clinical realism in scenario-based learning, and a lack of other situational factors, such as commercial pressures (Buchan et al. 2014).

Improvement science is part of the discourse of improvement in the NHS (National Health Service) to promote staff-led, localised improvements. It is presented widely in the health service as a desirable way of co-ordinating quality improvement and enabling involvement of staff (The Evidence Centre 2011). The introduction of improvement science to learning programmes requires students to learn a set of strategies and approaches that may differ from those required for the rest of their course, relating to the identification, implementation and management of improvements in the workplace, and then leading and working in clinical teams (The Institute for Healthcare Improvement 2017). Although there is evidence to support the positive effects of students leading

projects (Paterson et al. 2011) and of students leading quality improvement projects (Wong et al. 2010), the new configuration of their professional roles has sometimes been accompanied by negative consequences. Studies of quality improvement projects in the nursing curriculum have highlighted the discomfort and panic experienced by nursing students undertaking quality improvement projects (James et al. 2016). In terms of professional learning, the emphasis on audit and performance management might lead to deskilling, as professional judgement and expertise are less called upon. Working collaboratively in interdisciplinary teams presents new opportunities for defining professional practice, but there is also a need for translation as different worlds of practice combine. The instability that is required for innovation and change also interferes with the stability that is needed for continuity (Fenwick and Nerland 2014). Therefore, there are questions that need to be raised. For example, are the practices of improvement science being critically examined in enough detail to challenge underlying assumptions and attend to tensions between collaborative learning and the scientific approach to improvement? How is learning configured when carrying out SLISPs and are there more appropriate ways in which we could conceptualise learning improvement science for medical students?

## **2.5 Professional learning in improvement science**

This study is situated at the intersection of different fields of education research. The SLISPs studied in this research were being undertaken as an elective part of the formal curriculum in medicine and pharmacy, situating the research in post-compulsory, formal education. The SLISPs were carried out in the workplace and, towards the end of the students' courses, bringing in aspects of workplace learning, practice, and professional learning. This brings different notions of learning into play. The 'student as change agent' and 'student-led' aspects of the SLISP projects draw from leadership, learning and change, and from the concept of the leader as a subject expert (Rowe and Chapman 2015). In this section, several trajectories of learning are explored which intersect at the nexus where this study is situated. The section starts with professional learning, and tracks the history of approaches in this field, including the range of current studies drawn from in this thesis. The next part discusses the practice turn, and how this has influenced professional learning through the exploration of practice. Finally, the section outlines medical education and how this enacts different types of learning through the practices

of improvement science. This offers a rationale for the chosen approach of conceptualising learning as situated, contingent and dynamic.

### **Practice and professional learning**

Professional learning, as a field of inquiry, has undergone a number of changes in recent years, as scholarly practices become increasingly intertwined with the social (Hager et al. 2012). Learning is understood in organisation studies and education research as a socially situated activity (Gherardi et al. 1998). It has changed from having a focus on individuals and predictable input-output models to becoming systems-based with an emphasis on the sociocultural and sociomaterial. Traditionally, professional learning has favoured individualised approaches, such as training, workplace competencies and individual learning plans (Fenwick 2009). More recent sociocultural and sociomaterial approaches reconceptualise learning by moving away from the idea of learning as linear, individual and transferrable and towards being dispersed, situated and emergent. Hager et al. (2012) propose five principles for theorising professional practice: knowing in practice; sociomaterial; embodied and relational; unstable, heterogeneous and historical; and emergent. These are situated in two meta-traditions of neo-Aristotelian phronesis (relating to practical knowledge and ethics, action and experience as an alternative to the scientific-technical rationalities of traditional approaches); and post-Cartesian (challenging dualisms such as individual/social). These traditions and principles illustrate how practice, learning and change have become reconceptualised. It is now widely acknowledged in the field that there are advantages to viewing professional learning as a phenomenon that emerges from relational effects between actants rather than something that happens to individual workers. Mulcahy (2014) describes the development of theorising professional practice in ‘three tales of learning’. Tale One refers to learning as individual, cognitive and acquisitional. In this ‘tale’, personal skills, knowledge and attributes are valued. The second tale moves towards socio-cultural approaches, conceptualising learning as participatory, practice-based, situated, embodied and materially mediated. This allows learning to become viewed as social, moving away from skills and competencies and towards interdisciplinary and collaborative ways of learning. Finally, Tale Three conceptualises learning as sociomaterial. Unlike Tale Two, where materials are considered to be passive, Tale Three conceptualises learning as assemblage, where human and non-human are capable of acting.

Tale One has had an enduring influence in medical education and education in general. The study of medicine is rooted in a strong tradition of individual accountability, professionalism and scientific method (Bleakley 2012). The values of medical education foster approaches to education that support a high level of competence, autonomy and authority (McKimm et al. 2017). The Flexner Report of 1910 had an overwhelming influence on medical education worldwide and the values upon which this was built still reverberate in medical education today (Bleakley et al. 2011). The Flexner approach promoted the character of the ‘good doctor’ (Kuper et al. 2013), promoting the idea of the heroic individual (Bleakley 2014). The idea of learning as a cognitive process is reinforced in medical education by the assumption that doctors need to learn to be prepared for practice, rather than considering practice as part of learning (Dahlgren et al. 2012; Zukas and Kilminster 2012). The metaphors of ‘acquisition’ and ‘transfer’ that are dominant in individualised learning approaches have been problematised in practice and professional learning; these metaphors can be limiting and imply that learning and knowledge are ‘things’ that can be moved without being changed (Boud and Hager 2012).

In Tale Two, the notions of practice and participation have helped to shape the field of professional learning. This originates from the ‘practice turn’ where learning is now considered as embodied and material (Fenwick et al. 2014), socially ordered (Landri 2012), and relational (Price et al. 2012). The idea of communities of practice, legitimate peripheral participation, and situated learning, have established a lexicon that allows learning to be conceptualised as collective rather than individual (Brown and Duguid 1991; Lave and Wenger 1991). The practice turn challenged how learning was conceptualised, rejecting Cartesian dualisms such as mind/body, subject/object, nature/science, turning instead to learning as enmeshed, situated and ecological. For example, reflective practice is prominent in healthcare; however, this implies that ‘thinking’ is separate from ‘doing’, reinforcing the dualism (Fenwick et al. 2014). In approaching learning in this way, it is no longer possible to separate the knowing from the known, practice from learning, thinking from doing. This raises questions of how to articulate learning. The idea of communities of practice (CoPs) reconfigured learning in the workplace, but was critiqued for its limitations in terms of describing power relations and innovations (Fenwick et al. 2014; Fox 2000; Roberts 2006). Contu and Willmott (2003) claimed CoPs were aligned with managerial values and were embedded in relations of power. The concept of practice has been further theorised to gain a deeper



understanding of professional learning; such as emphasising ‘practice’ in communities of practice (Contu and Willmott 2003) and by referring to practices of community (Gherardi 2012). The terms ‘practice’ and ‘participation’ start to decentre the individual in the articulation of learning and move towards distribution in the collective. Unfolding practice sensitivity as an ‘embodied and materially mediated practice’ (Landri 2012) also introduces the concept of materiality.

Tale Three engenders the material turn, where sociomaterial approaches acknowledge practice and participation in learning as: (i) part of the whole system; (ii) interactions and relations between humans and non-humans; and (iii) learning and knowledge is embedded in action rather than internalised in a human participant (Fenwick et al. 2011). Learning and knowledge now become organising practices in human and non-human assemblages, rather than separate entities that can be possessed and measured. Reconceptualising learning as sociomaterial requires a shift in language and thinking. A number of theories have been introduced to facilitate the description of learning as sociomaterial. These include Cultural Historical Activity Theory (CHAT), complexity theory, new materialisms and ANT (Fenwick et al. 2011). Although CHAT is often included under the umbrella of sociomaterial theory, materials are considered to be mediated by humans (Fenwick 2014a), which would situate CHAT in Tale Two rather than Tale Three. In terms of improvement science, the document *Habits of an Improver* draws from psychologised models of learning to develop individual knowledge, skills and habits (Lucas and Nacer 2015). However, another guidance document, *Skilled for Improvement*, espouses the values of community and collective learning (Gabbay et al. 2014), which is more aligned with Tale Two. This thesis draws from ANT, which situates the approach in Tale Three. ANT provides a radical approach to the sociomaterial, which focuses on the relational, spatial and dynamic nature of learning and knowledge. This is discussed in more detail in the next chapter. My research explores SLISPs as a situated, practice-based, entwined experience, from which learning emerges through network effects rather than being a social or cognitive phenomenon (Ahn et al. 2015). By examining SLISPs with an ANT sensibility, we can begin to appreciate some of the detail and practice in its undertaking. Improvement science becomes a way of ‘doing’ improvement, a way of enacting interdisciplinary working.

## **Current studies**

As mentioned earlier in this chapter, the range of literature informing this thesis is drawn from different disciplines and traditions. The two main fields are quality improvement in healthcare and medical education. However, these fields also draw from other areas, such as healthcare processes and systems, quality improvement from other disciplines, education, and professional and practice learning. The studies of particular interest to this thesis also draw from socio-technical, sociomaterial, and ANT as theory and methodology. My decisions for including literature were influenced by different sources. I regularly attended a reading group for implementation science with the Nursing, Midwifery, and Allied Health Professionals Research Unit at the University of Stirling, where we discussed a number of current studies relating to implementation and improvement science. Although implementation science is different to improvement science, as the emphasis is on implementing change in a systematic way, there is much overlap with improvement science. The group was pivotal in advising me about the key literature in the field. Another source of current literature in improvement science was the SISCC. There are many studies and reports which informed my research but which I have not included as they lie beyond the scope of this research. Of interest to me were current studies in improvement science, healthcare and education (Armstrong et al. 2015; Davey et al. 2013; James et al. 2016; Lucas and Nacer 2015; Paterson et al. 2011). Included in this were two recent studies which described the educative experiences of nursing students as they undertook quality improvement projects (Armstrong et al. 2015; James et al. 2016). I also drew from quality improvement studies that did not have an education focus but contributed to the knowledge base of improvement science and quality improvement in healthcare (Aherne and Whelton 2010; Bate et al. 2014; Buchan et al. 2014; Holden et al. 2013; Peden and Rooney 2009; Rowe and Chapman 2015). I was also particularly interested in education studies which drew from sociomaterial and ANT approaches in healthcare (Ahn et al. 2015; Bleakley et al. 2011; Dahlgren et al. 2012; Falk et al. 2017; Fenwick 2014a; Ibrahim et al. 2015; Zukas and Kilminster 2014). Some of the ANT studies that were either situated in healthcare or education were very closely aligned with my research (Allen 2013; Decuyper and Simons 2016; Gorur 2012; Law and Singleton 2003; McMurtry et al. 2016; Mol 2002; Mulcahy 2014; Nespor 2012; Nespor 2014; Sørensen 2009; Verran 2001). Many ANT studies that influenced my research were seminal studies, but not situated in either education or healthcare (Latour 1987; Latour and Porter 1996; Latour and Woolgar 2013; Latour 1999a; Star 1990).

There is also an emerging field in medical informatics and systems which draws from sociotechnical, sociomaterial and, specifically, ANT approaches (Allen 2013; Berg and Goorman 1999; Bruni 2005; Cresswell et al. 2010). Thus, the literature informing my research was situated in many different and diverse fields and disciplines, which I drew together.

### **Learning in medical education**

In the UK, the disciplines of medicine and pharmacy have been historically separated, leading to detached streams of education. This separation, and the recent measures taken to develop the relationship between medicine and pharmacy, are demonstrated in a statement released in 2011 by the Association of the British Pharmaceutical Industry (ABPI) in response to a report published by the Royal College of Physicians (RCP).<sup>4</sup> The statement outlines changes to the ABPI Code of Practice, signalling a move towards more transparency, collaboration and joint working. Doctors are trained in the field of medical education and their profession is governed by the General Medical Council (GMC). The GMC has published standards for undergraduate medical education, in the document *Tomorrow's Doctors* (General Medical Council Education Committee 1993). The professional training of pharmacists is governed by the General Pharmaceutical Council (GPhC). In the UK, there are a growing number of academic courses for quality improvement in healthcare (Lucas and Nacer 2015). In Scotland, medicine and pharmacy students are being encouraged to undertake projects that engage with quality improvement practices and inter-disciplinary working. The standards in *Tomorrow's Doctors* include working and learning in a multi-professional team to improve patient care professionalism; the standards of professionalism also comprises clinical, ethical, legal and moral responsibilities alongside respect, politeness, consideration and trustworthiness (General Medical Council Education Committee 1993). In addition to these standards, the document, *Habits of an Improver* (Lucas and Nacer 2015), outlines the knowledge, skills and habits required for undertaking quality improvement work. Dornan et al. (2009) present a model of experience-based learning to support learning as affective, pedagogic and organisational. In Scotland, pharmacy students are encouraged

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<sup>4</sup> <http://www.abpi.org.uk/media-centre/newsreleases/2011/Documents/ABPI-Joint-Statement-supporting-changes-to-the-Code.pdf>

to engage with and influence the curriculum as partners in the learning experience (Buchan et al. 2014).

For the medical students, the university curriculum includes Student Selected Components (SSC), comprising clinical specialities and theoretical themes, of which improvement science projects number, amongst other options. The SSCs can be taken at various junctures in the curriculum, and are intended to develop critical thinking and higher level competencies (Paterson et al. 2011). The SSCs also serve to allow flexible time in the curriculum for students to work on projects whilst other students retake examinations. An SSC review in 2011 recorded how students had developed resources from the IHI to allow for quality improvement projects to be recorded and taken forward (Paterson et al. 2011). The research described in this thesis considers different types of projects, including a longer quality improvement project for a BMedSc (Degree of Bachelor of Medical Science) using improvement science methods, and an IHI Practicum group project that comprised an SSC (for the medical student) and improvement projects for degree dissertations (for the pharmacy students). The IHI Open School Quality Improvement Practicum<sup>5</sup> is accessed by the host university in the study as a way of containing a project and having the resources to complete it. The IHI provide guidelines for improvement projects and a facility for publishing projects on-line.

The curriculum developments previously described highlight a growing emphasis on inter-professional practice (Fenwick 2014a), inter-professional collaboration (Falk et al. 2017), and inter-professional learning (Paterson et al. 2011) in healthcare education. With the increasing influence of patient safety, inter-professional working is becoming more prominent, and different approaches to learning have been developed to promote this (Ahn et al. 2015; Bleakley 2014; Falk et al. 2017). Simulation is one method whereby health professionals can work as a clinical team in a low-risk environment (Bleakley 2014). In some cases, simulation is provided as an alternative to work-based learning. For example, pharmacy students cannot always get access to clinical placements, and simulation has been presented as an alternative (Buchan et al. 2014). Medical educators stress the importance of experienced-based learning (Dornan et al.

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<sup>5</sup> <http://www.ihl.org/education/IHIOpenSchool/Courses/Pages/PracticumFAQs.aspx>

2009), problem-based learning (Dahlgren et al. 2012; Grant et al. 2012), and working in clinical environments (Paterson et al. 2011). Studies in inter-professional learning have explored how knowledge is shared between healthcare workers, and how collaboration practices unfold (Falk et al. 2017; Fenwick 2014a). Sociomaterial approaches have been used to explore knowledge and learning in interdisciplinary working practices in medical education as a way of moving away from the dominant language of individualism (Bleakley et al. 2011; McMurtry et al. 2016) and cognitive approaches (Dahlgren et al. 2012).

Following on from the studies mentioned, this research provides an interruption to the literature on improvement science by applying the sociomaterial approach of ANT. The importance of this interruption has been demonstrated in a recent narrative review of the World Health Organisation Surgical Safety Checklist literature (Mitchell et al. 2017). The review argues that, since 2008, the literature on the checklist has been mainly focused on pre- and post-quantitative replication studies. The result of this is that the body of knowledge produced by the literature has not mobilised to produce a case either for or against the use of the checklist. As mentioned earlier in this chapter, the review calls for more detailed, qualitative studies to explore the socio-cultural aspects of the checklist. In the same way, this research contributes to and complements the literature around improvement science, leading to a more comprehensive understanding of improvement science in practice. The purpose of this research is not to investigate the effectiveness of improvement science or the changes it brings about to organisations. Rather, this research looks at what learning SLISPs for health professionals, specifically medical students, means in practice. This will be useful for educators and policy makers to gain a more in-depth understanding of how improvement science is enacted, and to inform policy and curriculum decisions.

This chapter has outlined the development of improvement science in healthcare, and how this has been translated into medical education. Professional and practice learning were drawn from to trace the trajectories into sociomaterial and the new insights this can bring to medical education and education in general. In particular, the literature highlights interprofessional learning in healthcare and the increasing need to focus on collectives rather than individuals. The contribution of the study described in this thesis is at the nexus of improvement science medical education. The next chapter extends the

sociomaterial contribution to education by introducing actor-network theory (ANT) as a way to explore detail and to attend to mundane, everyday activities that might otherwise have been overlooked.

## Chapter 3: ANT as Theory and Methodology

The purpose of this chapter is to introduce ANT and how it is situated in this thesis. The section begins by introducing ANT as a sociomaterial approach. Early, or classic, ANT ideas are introduced, focusing on networks and how these are explored in education research literature and seminal works that have influenced this research. The chapter then moves into a discussion of ‘after-ANT’ (Law and Hassard 1999). Finally, ANT is described in the context of SLISPs.

### **The umbrella term of sociomateriality**

In education research, ANT is included under the umbrella term of sociomateriality. The sociomaterial brings materials back into research, rather than solely focusing on humans, which helps researchers explore practice and find new ways of attuning to situations. Sociomateriality is becoming more broadly talked about in medical education (Falk et al. 2017; Fenwick 2014b; Goldszmidt and Faden 2016; McMurtry et al. 2016), with some studies focusing specifically on ANT in clinical practice, for example, surgical skills (Ibrahim et al. 2015). Fenwick et al. (2011) include complexity theory, cultural historical theory (CHAT), actor-network theory (ANT), and spatiality theories within this term. Fenwick et al. (2011) identify four commonalities that connect these theories: they all take on whole systems and the entangled nature of human and non-human action; they trace how bodies (such as bodies of knowledge) are stabilized through activity; and they de-centre the human by flattening hierarchies rather than making some things more important than others. However, it is widely acknowledged that the distinct traditions and histories of each of these approaches also need to be taken into consideration. For example, CHAT has emerged out of Marxist and Vygotskian conceptualisations of systems and learning, and has an established connection with education (Engeström 2001), whereas ANT has been developed in Science and Technology Studies (STS) and has been drawn into education (Fenwick and Edwards 2010; Nespor 2014; Sørensen 2009; Verran 2001). These histories are significant in terms of how concepts have developed over time, with different associations and traditions, and it is necessary to understand this diversity before applying an all-encompassing term such as sociomateriality.

As one of the sociomaterial approaches, ANT is viewed as more of a sensibility than a theory (Fenwick et al. 2011), and there are many discussions regarding the status of ANT as a theory. Latour’s (2005) argument is that ANT can be considered to be more of a



method by which the researchers can learn from the actors without imposing their own views. Mol's (2010) argument is that ANT findings are not synthesised into a framework, and that ANT is not applied in a deterministic or causal manner; empirical studies are considered as a way of developing the approach in a dynamic and fluid way (Law 2006). A very recent addition to the corpus of ANT theory papers introduces the notion of 'the ANT multiple' (Kanger 2017). This situates ANT as theory and methodology, presenting seven categories: ANT as an ontological and sensitizing framework; ANT as an empirical 'tool' to construct middle-range theory; ANT as analysis; ANT as framework for 'fluid' situations; ANT as guided methodology; ANT as ontological and methodological assumptions; and finally, ANT as undefinable. The implications are that ANT is at a stage where a broad range of studies have amassed in different fields and disciplines, and it would be helpful for future research to attempt to bring these together in some way, although this does not necessitate its culminating into an overarching theory.

Fenwick et al. (2011) argue that ANT is not a theory about learning but is rather a method to understand how effects, such as knowledge, identities, powerful centres and practices, are produced through assemblages of heterogeneous human and non-human elements. Rather than setting out a defined approach that is imposed onto a research study, ANT is performed into being by the growing number of empirical research studies (Law 2006), some of which are discussed later in the chapter. This research has specifically drawn from ANT to investigate improvement science in medical education. Coming from an education perspective, this work draws from Fenwick (2014b) and follows how ANT reconceptualises learning and knowledge for professionals in the workplace. The theoretical perspective is guided by Latour's empirical work (Latour 1987; Latour 1999a; Latour and Porter 1996; Latour and Woolgar 2013) and the reconceptualization of the social (2005). The work of Law (Law and Hassard 1999; Law 2004b) and Mol (1998; 2010) have also been instrumental in shaping the theoretical stance and methodological approach of ANT in healthcare. Adams and Thompson (2016) were also drawn from at a later stage to supplement the methodological narrative in this thesis.

### **3.1 Actor-network theory: a brief history and overview**

There are many ways to present ANT and many concepts and methodological devices to draw from. Part of the appeal and, conversely, the frustration of ANT is that it is

constantly being redefined through theoretical discussion and empirical research. This process serves to keep ANT vital but also makes it difficult to ‘pin down’. The result is a confusing array of claims and exclusions that sometimes appear coherent, sometimes not. As Law and Hassard proclaim:

actor-network theory is not something in particular. But then again ...  
neither is it simply a random set of bits and pieces, wreckage spread  
along the hard shoulder of the superhighway of theory. (Law and  
Hassard 1999:10)

The literature conveys ANT as diasporic (Fenwick et al. 2011), a collection of accounts (Law 2006) and as a theory in its loosest sense (Mol 2010). ANT has been referred to as: the sociology of translation (Brown and Capdevila 1999), the semiotics of materiality (Law and Hassard 1999), relational materiality (Law and Hassard 1999), and actant-rhizome ontology (Lynch in Latour 1999b). These terms describe some of the facets of ANT as pulling together matter and meaning, and as a way of seeing the world through connections. Although some of these labels perhaps more accurately reflect the approach, the three-letter ‘ANT’ acronym has endured. Latour (1999b), one of the most prolific and well-known contributors in the field, has criticised the acronym on the basis that ‘actor-network’ appears to support the agency/structure debate in the social sciences (which it does not) and ‘theory’ suggests a causal or predictive model (which it is not). Law (1999) talks about the ANT acronym as ‘a sign of replicability. Of its diffusion. Or, perhaps better, of its translation’ (Law and Hassard 1999:2).

ANT has been taken up in many different areas, such as management and organisation studies (for example, McLean and Hassard 2004); education (for example, Fenwick et al. 2014); health (for example, Law and Singleton 2000; Mol 2002); and medical education (for example, Bleakley et al. 2011). Historically, ANT is rooted in Science and Technology Studies (STS). Seminal works are situated in science and engineering, most notably Callon’s study of scallop fishing in St Bruic’s Bay (Michael 1996) and Latour’s studies of laboratory practices (Latour and Woolgar 2013). These reflect the development of ANT as an ethnography of scientific practices (Law 2004b). The impact of these works is far-reaching, and has presented science and sociology in new ways. For example, Latour and Woolgar (2013) shifted attention from human actors and interests

such as cognitive, institutional and cultural foci, and instead drew attention to how heterogeneous elements are aligned to produce scientific ‘truths’ (Michael 1996). In terms of ontology, ANT is orientated with post-structuralist thinking, where the idea of discovering aspects of external reality is replaced with the idea that reality is in flux (Law 2004b). Ideas in ANT eschew rigid categories which can shape assumptions (Fenwick and Edwards 2010): for example, a policy or a species of plant might be given a label and placed into a group that is built on previous ways of categorising, without considering how that policy or species is enacted in practice, or the forces and effects it creates, or how it might be associated with other entities. This positions ANT as a relational theory, reflecting ‘the view that a thing is defined solely by its effects and alliances rather than by the lonely inner kernel of essence’ (Harman 2010:75). In other words, an ANT analysis will explore a situation for its *relations* rather than the intrinsic properties of *entities*. This can be challenging and requires scrutiny of detail to build descriptions of enactment in practice. Law (2004a) relates ANT to the idea of baroque complexity, meaning that ANT has a predilection to look down into the detail of a situation through unfolding description, or ‘ponds within ponds’, rather than looking up at projected patterns and representations of the world. Rather than focusing solely on humans as the agentic actors in the workplace, an ANT study will consider relations and effects between components.

As well as questioning the position of the human, an ANT position challenges established notions of the social as being separate from nature or the material world. ANT thinking diverges from the idea of social constructivism by questioning the social (and human) as the creator of reality. Instead, Latour (1999a) refers to ‘circulating reference’, where metaphysical reality and constructed reality are not bifurcated but instead become part of the same way of thinking, as an ‘enriched version of realism’ (Harman 2010:73). Harman (2010) describes Latour’s idea of circulating reference as the ubiquitous translations that occur in the world, rather than modern philosophy’s insistence that translations are centred on the point between human and world. This rejection of bifurcations is critical to ANT thinking and is the core of Latour’s argument for equal treatment of humans and non-humans. Latour (2012) contends that modernity exacerbated, or purified, a rift between natural science and the social, which influences the way in which we are encouraged to see the world. By perpetuating this split, there is a risk that the social becomes more and more removed from the scientific, creating islands of reality that are

explored as separate entities. The implications of this rift are that ‘things’ such as beetles, earth, buildings, and diseases exist as isolated entities that can be measured, whereas the social constructs its own reality that is entirely separate. ANT affords an alternative ontology, where such dichotomies are challenged and the arbitrary boundaries that have been set up to isolate entities from each other are broken down. This is particularly important to stress in the context of this research, as the emphasis on a ‘science’ of improvement attempts to measure, monitor and scale up improvements within a social environment. Forcing these two worlds back together after (as ANT contends) falsely separating them is problematic because of the ontological differences. Conventional approaches do not currently enable the social and the material to be explored in the same way. An alternative ontology is required which can be found in ANT.

As a methodology, there is no ‘correct’ way to perform ANT. Unlike many other approaches, there are no set stages for the researcher to follow, and no model to fix on. Law suggests that this is one of the strengths of ANT, as: ‘Only dead theories and dead practices seek to reflect, in every detail, the practices which came before’ (Law and Hassard 1999:10).

### **Three dimensions of ANT**

Three ANT dimensions were identified and followed through the research: networks, symmetry, and multiple worlds.

The term ‘network’ is used to describe an assemblage of human and non-human entities that are held together through continual work to produce identities, environment and knowledge. The concept of networks has endured in ANT and has been the basis of many empirical works. ANT authors refer to the idea of networks as ‘classic’ ANT (Gorur 2012; Sørensen 2009). Classic, or early, ANT refers to the original studies and discussions from STS and the works of Callon and Latour on networks. For example, Callon’s principles of translation (Callon 1984) are a popular approach to studying actor-networks, and have been drawn from in empirical education studies (Nespor 2014; Zukas and Kilminster 2014). More latterly, and as part of the movement of after-ANT, networks have been problematised and reimagined to reflect the developments of the use of actor-networks in empirical studies (Latour 1999b; Latour 2005). Symmetry relates to the symmetrical treatment of humans/non-humans and is intended to ‘flatten’ hierarchies

pertaining to what might be considered more important in a situation (Law, 2004b). For example, many social science theories consider human action as being more important than other material relations that occur in the workplace, which can lead to practices being overlooked (Latour, 2005). The concept of symmetry stems from how humans and non-humans are treated within the network, and has been the subject of controversy (Latour 1999a), which is discussed later in the chapter. The critiques of symmetry have prompted discussion and debate contributing to after-ANT. Finally, the concept of multiple worlds has developed through writers such as Law (1999) and Mol (1998; 2002; 2010) to describe the irreducibility of the dualism of single and multiple. Multiple worlds relates to difference; rather than triangulating using different perspectives to consolidate meaning into a singularity, ANT unfolds what might appear to be singularities (such as improvement science) to explore the complex and diverse worlds they inhabit. The ‘after-ANT’ turn is outlined by some of its leading authors in *Actor Network Theory and After* (Law and Hassard 1999), describing how ANT has been presented and what it could become.

### **3.2 Attuning to networks**

This thesis explores networks, in the Latourian sense, that stabilise during the practice of SLISPs. The networks to which Latour refers are conceptual and dynamic, rather than something ‘out there’; they are about the translations and effects that occur when elements come together or ‘assemble’. An assemblage can be described as a group of objects, people, ideas and processes that have a relation to each other; what makes up the assemblage can be described as heterogeneous materials held together by forces and flows (Fenwick et al. 2011). Networks can be conceived of in practice as associations and relational forces, but these do not need to have the ‘shape’ of a typical network, such as a transport map or electrical system; these could just as easily be a piece of music or a workplace procedure (Latour 2005). The network is of interest because of how it exposes relations and explores the stability, movement and strength of connections: networks can take account of what has been overlooked (Latour 1999a) by focusing on the effects of relations rather than the entities themselves. The term ‘network’ and its prominence in ANT has become problematic for several different reasons. Latour (1999b) identifies how networks have become more closely associated with the internet. There is also the

connotation that networks are socially constructed, and easily visualised with ‘nodes’ (people or objects) that are connected (usually in straight and even lines) to each other.

The term ‘black-box’ has been used in ANT to describe how processes become stable and immutable, and any internal complexity becomes taken for granted (Fenwick and Edwards 2010). The idea of becoming taken for granted implies that some processes become hidden. Law (2004b) describes the method assemblage as an approach which implicates the ideas of presence: in other words, by making something present other things are being made absent. The idea of giving ‘voice’ to objects is a way of making objects visible and not overlooked (Latour 2005). An object or representation renders something present, with absences being either manifest in what is present, or rendered ‘other’ through being repressed or hidden. The method assemblage is about resonance, amplifying some things and silencing others (Law 2004b), and describes the way in which things become visible in networks. Another way in which networks present visibility is through what Latour (2004; 2005) refers to as ‘matters of fact’ and ‘matters of concern’. Controversies are settled and presented as ‘matters of fact’ which are accepted as objective and naturalised. There is also a risk of collapsing everything into the network: where to ‘cut the network’ is a dilemma that the researcher is constantly required to justify (McLean and Hassard 2004). One of the problems in cutting the network is knowing what to include and what to exclude. As mentioned earlier, the dilemma becomes one of favouring some actants over others. Early, or classic, ANT has been criticised for foregrounding the ‘big’ or most prominent actors in ANT accounts (McLean and Hassard 2004), thereby relegating other actants to the background or context. This leads into discussions on the imbalance or asymmetry that can occur in ethnographic accounts, and explains how ANT has held on to the tenet of symmetry despite numerous criticisms. This is discussed in more detail later.

### **Translation**

One of the most important features of networks is the way in which entities are transformed by other entities in the network. That is to say, when practice is enacted, the connections and associations that take place transform the entities enacting those connections. This is referred to as translation. Latour and Woolgar (2013) describe the process of translation as one in which activities are transformed through a network of inscription devices. Inscription devices are networks of elements that construct a reality

(Law 2004b). Latour and Woolgar's (2013) ethnography of laboratories presented the term 'inscription device' to describe a system or process of translation that occurred in laboratory practices. An inscription device usually refers to a system that transforms materials and names the outputs, thereby making relations between instruments and traces; for example, the process of turning laboratory tests into scientific papers. In ANT, the focus of interest is what things *do* rather than what they *mean* (Fenwick et al. 2011), and *doing* brings about change. This is significant in education, as traditional models of learning are built on the assumption that learning and knowledge are stable, essentialised 'things' which can be 'transferred' and 'acquired' without change (Boud and Hager 2012). ANT challenges these assumptions by focusing on the relations and associations that occur as entities interact; new connections not only create new networks, but the entities themselves are changed through translation. For example, Berg and Goorman (1999) argue about the contingency of medical information, as the information exists only in association with surrounding information. The process of translation can be described as traduction, or treason (trahison) (Brown 2002). This allows networks to be conceptualised as dynamic and unstable, rather than causal or predictive. In practice, translation can occur through enactments and devices in the network.

### **Networks in education research**

The concept of networks has been applied to prominent studies that have informed much empirical work in the field of ANT in education (Nespor 2014; Sørensen 2009). Nespor's work followed two disciplines (physics and management) in post-compulsory education. Nespor (2014) was keen to emphasise, following Latour (2005), that an ANT lens provides a way to describe and move data rather than to explain it. Nespor focuses on movement and space/time to describe learning and knowledge:

... people move through space materially, and simultaneously move and construct space-time through practices of representation, and what we call 'learning' are segments of motion which follow the shapes of more stable institutional or disciplinary networks. (Nespor 2014:131)

He explains that having knowledge means that you participate in an actor-network, which can be a field of practice; in other words, a 'discipline'. Participation involves movement around that field, around networks of power. Nespor continues:

To understand learning and knowledge it's just as essential to trace out the network structures and the political economy that sustains them as it is to study students' experiences in specific settings of pedagogy or practice. (Nespor 2014:132)

So far it has been demonstrated that the concept of networks moves far beyond a semantic map of nodes and connections. As Nespor highlights in the above quote, networks are also about describing the 'political economy'. Another facet of networks is how power is enacted. Translations and relations constitute power through assemblages and networks. For example, Fenwick and Edwards (2010) describe the power in educational spaces such as a lecture theatre, where there is a screen and stage at the front with seats fixed in this direction. Actor-networks describe dynamic, shifting, mutating conceptions that help to trace power relations through a process of translations between entities (Fenwick and Edwards 2010). What might be referred to as the properties (an essentialist term) of networks include descriptions of the ways in which actants engage with the network. Specifically, these need to be considered alongside the phenomenon of translation, and how this transforms actants as they assemble and form connections within a network. However, some actants become so well established and performed within a network that they can be transported without transformation: as Latour describes, like cannonballs. Immutable mobiles are actants within a network that hold their shape of relations sufficiently to be able to be displaced without transforming (Latour 1987). Some immutable mobiles can become Obligatory Passage Points (OPPs) (Callon 1984). Latour (1993) describes OPPs as a point at which actants are obliged to pass to continue acting. Latour (1993) uses the example of the transmission of the gonorrhoea microbe from mother to baby: in this case, the OPP is the eyelashes of a new-born infant, to which the microbe adheres during the birthing process; without this attachment, it would be difficult for the microbe to spread. The OPP provides a way of describing the order of enactments, the path of actants, and where work needs to focus to continue the practice. OPPs can also be described as assemblages where relations within the network are required to pass, and can affect the flow of power in a network (Fenwick and Edwards 2010).



### 3.3 ANT and symmetry

The concept of symmetry in ANT distinguishes it from other sociomaterial theories, such as CHAT and complexity theory. The ANT researcher is not seeking the depth and meaning through actions, but a focus on the actions themselves and what unfolds in a particular situation, without privileging humans. To return to Mulcahy's (2014) Tale Two in the last chapter, socio-cultural approaches consider materials as being mediated by humans, with humans remaining at the centre; alternatively, sociomaterial approaches seek to de-centre the human by focusing on relations and effects, rather than separate entities. What we see in everyday practice has inevitably come from agency sources that are spread throughout out time and space. As Latour (2005) describes:

any given interaction seems to *overflow* with elements which are already in the situation coming from some other *time*, some other *place*, and generated by some other *agency*. (Latour 2005:166, original emphasis)

Whereas other social theories might trace agency, motivations, intentions, history and underlying meaning, what is of interest to ANT is the actions and interactions between entities that grow in a flat, rhizomic way, without seeking deeper meaning and causes. Returning to the origin or source of agency is rejected in favour of the here and now Latour, (2005). As an example, visualise entering a workplace such as a hospital or a bank or a manufacturing plant where you are confronted by practices that are an interaction of people and things; the agency of the action cannot be traced back to the source.

A plaintiff summoned to face the judge discovers the edifice of law firmly in place and the Old Bailey building as ancient as London. A worker, who labours all day on the floor of a sweatshop, discovers quite quickly that his fate has been settled by invisible agents who are hidden behind the office walls at the other end of the shop. A pedestrian with a strained ankle learns in the doctor's office about her skeleton and the physiology that predate the time of her accident. A local 'informant', prodded by the questions of a visiting ethnographer, realizes that most

of his habits of thought are coming from places and agencies over which he has no control. (Latour 2005:166)

An ANT sensibility holds that practice can be better understood by focusing on relations between entities that form networks of practices. Rather than separate and categorise students, staff, patients, pens, paper, PCs, wards, beds, reports, tests, and so on, ANT focuses on the effects that are produced when these entities relate to each other and form networks. Central to this is the idea that entities do not have an essential, unchangeable presence, but that all things exist by their associations with other things. Unlike many social theories that strive to produce representations of the social by producing patterns and models, ANT is non-representational and descriptive. This enables the researcher to approach a situation and record actions, relations and practices with a view that all things acting are treated equally, or symmetrically.

As previously described, ANT focuses on networks and relations, at the dynamic and shifting associations between entities rather than fixed individual entities. This raises questions about how the researcher (a human) represents humans and non-humans, and about how non-humans participate in the social (McLean and Hassard 2004). Law (1992:383) describes how humans are positioned within symmetry: 'what counts as a person is an effect generated by a network of heterogeneous, interacting materials'. In relation to this research, one could ask, what is a student? Or, more pertinently, how is a student performed into being? Clarke (2002) provides an empirical description of students as 'subjects and objects of knowledge [that] can be observed empirically as entities circulating in networks' (Clarke 2002:107). Clarke (2002:120) concludes by stating:

The contribution of actor-network theory to this task is to provide a rich fund of ready-made examples to learn from, and to suggest points of departure for new stories about *how* people learn *what* they learn, and how adult educators decide what other people ought to know.

This quote supports the notion of ANT as a sensibility that considers what things do rather than what they are; what effects elements have within their particular networks and what associations are formed. In terms of how knowledge is conceptualised:

knowing, or coming to know something, is regarded as something that emerges as an *effect* of the socio-material arrangements that gather together and are performed into being through the continual transactions. (Ahn et al. 2015)

The idea of symmetry relates to how elements within a network are treated. In many social science approaches, humans are considered as the source of all agency. This has led to social science studies privileging the human. Symmetry describes how dualisms are challenged in ANT, for example, humans are not foregrounded in favour of non-humans, as commonly happens in sociological theory. In ANT, symmetry originates from the idea of modernism and the bifurcation of nature and science, as mentioned earlier in this chapter. Symmetry is also about approaching a situation without taking on the assumptions of whether something is scientifically true or false (Law 2004b); by privileging truth over falsity, one enters the world asymmetrically, with a leaning towards some assumptions over others. ANT argues that assemblages are best described symmetrically; that is to say, not in terms of true and false beliefs shaped by history, but in terms of how a situation is shaped by the natural and social world Law (2004b). The risk of asymmetry is to ignore actants and relations that are significant but presumed unimportant. The ANT concept of symmetry holds that these assumptions and values have the potential to skew 'how we see the world'; indeed, the preceding statement is invalidated by symmetry, as 'we' are inseparable from the world, and our 'seeing' does not validate any foregrounding of important actors. Following this logic to its inevitable conclusion, symmetry, by not privileging the human, then gives voice to nonhumans. The choice of language here is significant: the selection of the word 'non-human' rather than 'object' is because the term 'object' immediately conjures a 'subject' (Sayes 2014); the term 'things' has similar connotations and represents a body of thought about how nonhumans are already situated in a human world. Ascribing agency to nonhumans has implications as to how materials are politically involved and enmeshed in the social. Abrahamsson et al.'s (2015) description of how Omega 3 is ingested and becomes part of the human that ingests it goes beyond a passive description of the place of food in biological activity. Abrahamsson et al. (2015) conclude that it is relational materialism that acts, things do not act alone; it is not about 'what' acts, but how the actions push and pull. Rather than saying 'causing' and 'acting', we should be saying 'affording' and 'responding'; 'caring' and 'tinkering'.

In ANT, symmetry has become known as treating objects the same as humans, which has led to scepticism by a number of authors in the field. For example, some writers assert that ANT ascribes agency and intent to non-humans, to allow them to act and influence a situation in a particular way (McLean and Hassard 2004; Pels 1996). The awkwardness of dealing with symmetry has led to some ANT analyses either glossing over the subject or going too far and becoming radical. McLean and Hassard (2004) describe this dilemma as symmetrical absence or symmetrical absurdity. Symmetrical absence can lead to exclusion of the idea or a preference for asymmetry. These concerns have been taken up in posthumanist approaches which propose ‘interviewing the object’ as a way of giving voice to non-humans (Adams and Thompson 2016) and authors such as Bruni (2005) have explored this in ANT accounts of clinical work practices. Some of the criticism aimed at ANT, and in particular, symmetry, are outlined and discussed in the next section.

### **ANT will eat itself<sup>6</sup>: key critiques of symmetry**

Of the many critiques aimed at ANT, the notion of symmetry appears to be a main target. The idea of the sociomaterial is to include the material in sociological accounts, where traditionally the material would be overlooked because of the focus on human activity (Fenwick and Edwards 2010). This shift in thinking brings with it controversy, particularly against the backdrop of humanism in sociocultural theories; arguments against ANT challenge the relegated position of the human as the subject, and raise moral implications of flattening reality so that a door has as much significance as the person walking through it (for key critiques, see: Collins and Yearly 1992; McLean and Hassard 2004; Miettinen 1999; Pels 1996). The argument of Collins and Yearly (1992) in *Epistemological Chicken*<sup>7</sup> is that ANT produces overly detailed accounts of practice that are dull and irrelevant. However, McLean and Hassard (2004) contend that detail is

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<sup>6</sup> This heading is an adaptation of the pop band ‘Pop Will Eat Itself’, the name of which was taken from a quote by David Quantick of the New Musical Express. Quantick describes the incestuous way in which pop music recycles its own material and presents this as new. Some of the critiques of ANT from SSK claim a similar phenomenon: that ideas from the social sciences are recycled rather than creating new ideas.

<sup>7</sup> The reason for this rather amusing title is the authors’ assertion that Latour and Callon, through playing out the ideas of symmetry, are pushing each other into more radical epistemological positions. This is compared to the children’s game of ‘chicken’ where one child dares the other to go further until they decline; this is the point at which they are labelled a ‘chicken’.

important, even though it is sometimes prosaic; we ignore the mundane to our peril, because this is where the work is situated. Collins and Yearly (1992) argue that ANT has not added anything significantly new to the field of the Sociology of Scientific Knowledge (SSK), and that the way ANT is presented tends to over-claim its relevance to sociology. Miettinen (1999) argues that ANT's main methodological flaws render ANT unsuitable for the study of innovation. These flaws are described as:

the problem of structuring the analysis of the network and selecting the relevant elements or actor, the problem of silent actors, and the problem of human capability or intentionality in explaining the establishment of network associations. (Miettinen 1999:181)

Pels (1996) appeals for alternative positions of symmetry, rather than the radical stance taken by Latour and other ANT theorists. Pels' (1996) argument is that approaching a situation symmetrically creates distance and detachment that may be translated as disinterested, dehumanising, apolitical and amoral. Other writers have argued about the unsuitability of ANT in particular situations. McLean and Hassard (2004) also call for caution in relation to symmetry, citing examples where symmetry had either been omitted or taken *ad absurdum*. However, some of ANT's greatest critiques come from the originators themselves (to name but a few: Brown and Capdevila 1999; Latour 1999b; Law and Hassard 1999; Mol 2010). Some of these critiques were included in a collection of papers that formed a seminal work on 'after-ANT' (Law and Hassard, 1999).

### **3.4 After-ANT: multiple worlds**

The movement of after-ANT created space for other ideas of relational and material ways of considering situations. As Sørensen (2009) observed in her ethnography of education, the networks concept was helpful for empirical descriptions, but did not always 'fit' with her ethnography. Other concepts in ANT, particularly in after-ANT, draw from spatiality and fluidity, which Sørensen found to be more appropriate to attune to fluidity and ambiguity in the data. ANT writers such as Mol (2010) and Law (2004b) began to develop a wider range of metaphors to describe the messiness of practice, and to enable descriptions to include difference, uncertainty, ambivalence and ambiguity. There are subtle differences between these terms that need to be explained before they are applied

empirically. Uncertainty signposts to doubt and a lack of conformity; there must also be an assumption of the norm and how things are categorised. Ambiguity refers to an openness, a resistance to consolidating or closure; a slipperiness of meaning. The term ‘ambivalence’ is different from uncertainty and ambiguity because it carries with it a certain energy. Ambivalence in human thought in the field of health behaviour change has been described as an ‘accountant’s balance sheet’ (Mason and Butler 2010:n.p.). It pertains to a polarisation of thought and oscillation between these poles. Rather than ‘sitting on the fence’, ambivalence can point to dissonance and angst. Moving away from psychology and towards the sociomaterial, ambivalence implies force and agency in the relation between heterogeneous objects that fluctuates rather than being unidirectional, creating what Fenwick and Edwards (2010) refer to as ‘strain’.

In an ANT analysis, difference is followed, troubled and unfolded in divergent trajectories, allowing detail to emerge. As the authors (Fenwick and Edwards 2010) point out, many models and theories attempt to smooth out complexity, whereas ANT looks down into the baroque detail. Bleakley (2012) likens the divergency of ANT as the opposite of triangulation, throwing open possibilities rather than consolidating difference into a single point; and as Latour (2005) suggests, ANT is more like the oligopticon, seeing little but seeing well, as opposed to the panopticon, which sees all. This process of unfolding brings us back to the dilemma of where to ‘cut the network’; like Zeno’s paradox, the opening out becomes *regressus in infinitum*. This line of argument also draws attention to the idea of approaching something that appears as a singularity (for example, a medical condition) but unfolds in practice into a multiplicity.

### **Multiplicity and ontological politics**

Mol’s (2002) ethnography of atherosclerosis and how this is enacted in hospital practice draws attention to the multiplicity of ‘worlds’, how these worlds ‘hang together’, and how enactments become political acts. The term ‘praxiography’ was described by Mol (2002) as an ethnographic approach that explores uncertainty and difference, maintaining the messiness of practice. As Law (2004) describes it, praxiography allows for the exploration of how objects are continually enacted. Mol (2002) employed praxiography to explore the idea of what atherosclerosis ‘is’ and how this situated and enacted in practice. Through studying these enactments, Mol (2002) described how atherosclerosis, far from being a singularity, was actually performed as a multiple. However, this did not

extend to being many different things: the condition is not plural. The multiple enactments signposted to different worlds of practice where atherosclerosis 'is' a tissue sample on a slide, and an account of symptoms by the patient, and a diagnosis by the doctor.

Continuing the notion that practice networks produce reality, Law (2004b) suggests that these different realities can be viewed as different worlds; realities are produced along the way, which Law (2009) refers to as 'collateral realities'. The conditions of possibility that exist within a world are shaped by intervention and performance (Mol 1998). By focusing on the 'world' produced by practice, the researcher can appreciate the particular rather than the general, and can attune to the relations and practices within it and develop a sensibility within that world (Law 2004b). This is a departure from the idea of the 'singular' reality 'out there' that is propagated by Euro-American metaphysics and dominates scientific thought.

Mol (2002) also builds on the idea of multiple worlds to conceptualise how the same worlds can exist side by side, and if they interact or subsume one another. In order to regulate difference, Mol summarises the different ways in which worlds exist to either reconcile difference or sustain multiplicity, and this idea is further developed by Law (2004b). Reconciliation of worlds is achieved in different ways by: *layering*, of which the 'body multiple' is an example of an underlying condition bringing about symptoms and diagnoses which conflict; *a single narrative*, where the story of a phenomenon is smoothed over; *translations*, where one process turns into another or is converted; *submission*, where one world dominates another; and *rationalisation*, where inconsistencies are glossed over by narrative. Alternatively, multiplicity can be sustained through mutual exclusion, creating different or composite objects, and location in different places. Multiplicity can be disguised, but by observing practice through praxiography, these multiplicities can become evident. The implication of considering multiple worlds is that it presents questions regarding how worlds are conceptualised and treated, rather than being obscured (Fenwick et al. 2011).

If one accepts the idea that practice precedes reality (rather than the Euro-American metaphysical standpoint that reality exists 'out there' and therefore precedes practice), then it follows that because there are multiple practices, there are therefore multiple

realities (Mol 2002). If there are multiple realities, then there must be ways of reconciling or sustaining this multiplicity. Following the idea that sometimes worlds submit to other worlds, there must be scenarios when one version of reality dominates another. The notion of ontological politics challenges the conditions of possibilities that exist in different worlds, as there are different (political) reasons for enacting one world over another. Bleakley (2012) describes ANT as a research practice that challenges conventional evidence in medical education by exploring multiple possibilities rather than a singular meaning. This emphasises the difference in conceptualising research methods, and how evidence-based practice in medical education has a fixed notion of rigour that can be challenged.

### **3.5 ANT and SLISPs**

The arguments for attending to the sociomaterial are compelling, especially for practitioners and researchers who work with equipment and technology in the workplace. It appears intuitive that materials are brought to bear in the workplace as these are visible and an intrinsic part of practice. The challenge, however, is in moving away from the idea that we need to compartmentalise and categorise in a conventional manner, ultimately for the purposes of reducing and generalising data. Many research approaches treat data in this way: the researcher gathers a large amount of information and it is then necessary to condense it. ANT, however, moves in the opposite direction. Ambivalences are troubled and unfolded, ambiguities are explored in a baroque ‘ponds within ponds’ way to draw out more, not less, detail (Law 2004a). This poses a problem for researchers: how is the analysis representative of the whole, how can it be packaged and made sense of? The answer is not in representing but in describing detail. Analysis then comes out of the emerging detail, rather than in the reductionist and representational decisions of the researcher.

SLISPs combine a range of pedagogical approaches such as eLearning, experiential and project working, classroom work, simulation, lecturing, supervision and formal assessment. These are pedagogical decisions that also act on the network and influence the learning effects that emerges. The multiplicity of SLISPs is drawn out by considering different conceptualisations of learning in improvement science. There is also the implication in SLISPs which brings with it the permission to improve workplace



practices. The published projects and endorsement from senior clinical leads legitimizes improvement science as a way to implement improvement, and a further network effect.

### **Attending to language**

As discussed before, because ANT draws from post-structuralist traditions, the meaning of particular words is shaped by their association with other words (Law and Hassard 1999; Mol 2010). ANT subscribes to the view that meaning is contingent, therefore meaning will be translated rather than transported (Law 2006). The word 'network' is an example of where the use of a word has changed with the introduction of the internet (Latour 2005). The meaning of other words also carry connotations and connections with meaning that might not be intended. For example, (Nespor 2014) and (Sørensen 2009) write about the use of the word 'performance' and how this becomes associated, in the social sciences, with Goffman's theatre analogies; this meaning is incongruent with the use of performance in ANT, which uses the word to describe how situations unfold in space/time rather than describing what is 'backstage'. (Mol 2010) advocates the use of the word 'enact'; although this has other associations, she explicitly asks her readers to approach the word as 'fresh' (Mol 2002; Mol 2010). In this chapter, the word 'activity' is sometimes used, which is associated with human action and therefore is asymmetrical (Sørensen 2009). McLean and Hassard (2004) engage with controversies directed towards ANT and symmetry in terms of its distancing from the human (Pels 1996), potential amorality (Miettinen 1999), and for pushing epistemology beyond reasonable philosophical arguments. These arguments cause tensions to surface when attempting to de-center the human, as ultimately it is a human employing the language to describe reality; this dilemma could almost be described as Munchausian, as to separate the human from language would be 'to pull oneself into existence out of the swamp of nothingness by one's own hair' (Nietzsche 2003:21). ANT descriptions require sensitive language towards materials and a balanced treatment of humans and non-humans. Authors have identified the different ways in which language is used to describe humans and non-humans as changing register (Hassard et al. 2012) or being out of tune (Sørensen 2009), which indicates asymmetrical treatment. Regarding humans, ANT's position is that agency and intentionality does not reside with the individual human, but is instead an effect of associations within a network (Fenwick and Edwards 2010).

To address these dilemmas, some authors have put forward terms that follow the ontological nuances of ANT. Fenwick (2014b) uses the terms: attending, attuning, noticing, tinkering, and interrupting, to focus on workplace learning. Abrahamsson et al. (2015) articulate a preference for the words affording, responding, caring and tinkering over the words causing and acting. In this thesis, the term 'attuning' is used to express resonance and fine-tuning, in favour of words that imply unidirectional movement or cause and effect. The term 'invite' is used in relation to materials and how they are situated in practice. It is an alternative expression to 'afford' which has connotations in cognitive psychology. In this thesis, the word 'invite' is preferred over 'afford', as the former is considered as performative: entities are actively invited into networks, rather than 'affordances' passively waiting to be taken up.

In this chapter, a historical context of ANT was provided under the umbrella term of sociomateriality and in terms of professional learning. ANT was identified as both an ontological position and a methodological approach. Empirical and theoretical studies drawing from ANT in the field of medical education have been described in this chapter to explain how the research in this thesis contributes to existing literature. Three dimensions of ANT (networks, symmetry and multiple worlds) were foregrounded and described; these are taken forward into the analysis and throughout the rest of the thesis. The dimensions are problematized by drawing from seminal critiques in the field relating to the use of networks in classic ANT and philosophical problematics with the concept of symmetry. Ontological politics has been introduced as way of describing the dynamics of multiple worlds, and how worlds of practice coexist or compete. The justification of an ANT approach to explore SLISPs was presented. The ongoing issues relating to language were outlined, and this is something that continues to be addressed throughout the thesis. The next chapter introduces how the analysis was structured through the formation of three anecdotes (one from each cohort and one combined) which were then analysed through the three ANT dimensions of networks, symmetry and multiple worlds.

# Chapter 4: Researching Student-led Improvement Science Projects: Study Design

In this chapter I outline the research strategy in relation to the theoretical orientation. This chapter is split into two parts. In the first part (4.1) I start by outlining the methodology of my research by describing the specific guiding principles from ANT and how these shaped the fieldwork and analysis. I then go on to outline the strategies I took to ensure rigour and validity, and the problems associated with these.

The second part (4.2) describes the methods I employed and provides an overview of the analysis and how this was carried out. I describe how the fieldwork was set up, including the initial meetings with contacts and the ethics process. I then briefly outline entering the field. The two cohorts are then described, including a summary of the participants, study sites and SLISPs. I go on to describe the different types of information I collected in the field, such as documents, interviews, fieldnotes, and photographs. In the final section I return to the specific ANT concepts that I drew from to describe my analytical strategy in light of the data that I had collected.

## **4.1 Orientation and strategies**

### **Ontological orientation of the analysis**

According to Martin and Kamberelis (2013), positivism and post-positivism remain the most dominant approaches in education research. In positivist ontology, the researcher strives to be objective; the assumption is that there is a 'real truth' out there for the researcher to discover, with its own inherent meaning. In education, positivist approaches are used to measure performance, and positivism is a dominant approach in medical education research and improvement science; but this can be problematic. For example, in the classroom, observed behaviours are subject to interpretation, which cannot be adequately explored through positivist approaches (Pring and Thomas 2004). It is becoming more widely accepted in medical research that a positivist stance is not always appropriate to reflect the nuance of social and material interactions; for example, as outlined in the open letter to *The BMJ* that calls for more qualitative approaches to be published in the medical literature (Greenhalgh et al. 2016).

Research based on positivist values presents an ontological position where 'phenomenological experience ... is assumed to be essential, stable, and universal' (Martin and Kamberelis 2013:670). In the analysis of workplace practice, essentialism

and universality can be problematic and engenders research approaches based on assumptions of a reality that is ‘out there’ (Law 2004b). As an alternative, Martin and Kamberelis (2013) suggest an approach to analysis that is more like mapping, which accommodates open and unpredictable systems more suitable for studying practice. In other words, an approach to the data that creates new paths rather than tracing existing ones. Mapping may be more suited to post-structural approaches that are required to open out concepts rather than closing down into categories. For example, grounded theory may be considered to have a convergent trajectory by continually grouping data into codes and categorisations (Denzin and Lincoln 2005). In contrast, ANT could be said to have a divergent analytic trajectory, where the object of inquiry is constantly interrupted and intervened to challenge its status as a singularity. The aim of grounded theory is to condense, and the difficulty of this strategy is knowing how to group things together. The aim of ANT is to disperse, and the difficulty of this strategy is knowing where to stop, or where to ‘cut the network’ (Fenwick et al. 2011). Fenwick et al. (2011) describe ANT as striving to represent complexity, and not to ‘iron out the wrinkles’ to present a flat, linear representation of the fieldwork. Law (2004b) describes ‘looking down’ into the detail of practices rather than ‘looking up’ at overarching structures; the curlicues of the Baroque as opposed to the weightless dreams of the Romantic. Mol (2002) presents the idea of ‘praxiography’, a form of ethnography, as a way of exploring uncertainty without closing down complex ideas by explaining phenomena. The strategy for this analysis is therefore mapping new paths through the data, through inquiry and questioning. The concepts of networks and praxiography are explored in more detail later in this chapter.

As introduced in Chapter 3, this study has taken the sociomaterial position of ANT by considering knowledge and learning in space/time: ‘It is in these organisations of space and time that we will find the key to understanding how students “learn” in fields of “knowledge”’ (Nespor 2014:16). When knowledge and learning are considered in this way, the notion of measurement becomes elusive and requires a different set of research strategies to measuring knowledge and learning as static and reified. In a workplace environment, practice is not necessarily individualised and cannot be easily separated into isolated components. In other words, it can be difficult for an observer to separate the work of an individual when they are working in clinical teams and carrying out different processes that overlap. The implications of considering knowledge and learning

as social, situated and material are that relational effects become entangled and contingent (Landri 2012). In medical education, this reconceptualization requires a different way of thinking about educative approaches. In many ways, sociomaterial approaches are more aligned to the mess and complexity of the hospital ward than more traditional approaches that measure and assess separate components. For a sociomaterial approach, the researcher is required to notice how materials (bodies, documents, equipment, furniture) and social dynamics (meanings, decisions, interactions) are enmeshed, allowing taken for granted or hidden forces to be made visible (Fenwick and Nimmo 2015).

The aim of the research described in this thesis was to conduct an analysis drawing from an ANT sensibility, which is non-representative, divergent and exploratory. To achieve this, I started by identifying some of the guiding principles of ANT that I felt would be helpful for the analysis. My decisions were based on the literature, particularly drawing from empirical studies in ANT (Latour 1987; Latour 1999a; Latour and Porter 1996; Latour and Woolgar 2013), ANT and education (Nespor 2014; Sørensen 2009) and ANT and healthcare (Law and Singleton 2000; Law and Singleton 2003; Mol 2002). These studies were helpful for practical considerations, as well as demonstrating how the authors had drawn together ANT with ethnography in the field and subsequent analysis. I closely followed literature that drew together central issues of ANT in education research (Fenwick and Edwards 2010), ANT in medical education (Bleakley et al. 2011) and the development of classic ANT to after-ANT (Latour 1999b; Latour 2005; Law and Hassard 1999; Mol 1998). I first turned to Latour (2005), Nespor (2014) and Sørensen (2009) for their descriptions of networks and how these were presented empirically. The concept of networks is described in the next section. Although the concept of networks helped me to navigate through my fieldwork and analysis, I felt that more could be drawn from ANT. Because so much had been written about the concept of symmetry in ANT, especially in the critiques, I felt this needed to be addressed as a perspective in my research. I drew from Law (2004b) and Mol (2002) for more after-ANT developments relating to analytical methods to explore SLISPs.

### **Guiding concepts from actor-network theory**

There are many tools and concepts that ANT affords, coming from different authors, traditions and times. For example, Callon's 'four moments of translation' describe different ways in which networks become stabilised in practice: through

‘problematization’ and how the problem is framed; ‘interestment’ or how entities assemble or are excluded; ‘enrollment’ of actors into the network; and ‘mobilization’ through stabilization of a network (Callon 1984). There are examples of ANT analyses in education that draw from the four moments of translation (Nespor 2014; Sørensen 2009; Zukas and Kilminster 2014). Although this approach has proved to be fruitful, I elected not to apply this framework as I wanted to develop my own methodology that would also include more recent developments in ANT. Other ANT studies in education focus on specific features; for example, Edwards et al. (2009) place a focus on the concept of ‘tokens’, referring to objects or discourses that are continuously translated and changed as they move through space and time. Fenwick (2009) draws from notions arising through the after-ANT movement to ‘appreciate the spaces or blanks beyond networks’ (Fenwick 2009:98). In my thesis, I have concentrated on three specific ANT concepts to guide the analysis: networks, symmetry, and multiple worlds, as these are the prominent ethnographic methodologies in ANT which attend to recent theoretical developments. I adapted these three dimensions from a list of five (Fenwick and Edwards 2010) as a way of drawing out more mature ANT concepts (networks and symmetry) and more recent, after-ANT ideas (multiple worlds). These three dimensions are not discrete and there is overlap. However, I have treated these as a way to focus on facets of the research, to draw out insights that will address the research questions. My research aim was to investigate student learning during the process of carrying out SLISPs. My theoretical orientation conceptualises learning as a network effect which is dynamic and contingent. To explore this aim, my research probed the network effects that were produced during the projects, and what observable practices were recordable. A focus on networks was necessary to answer these questions, but introducing other ANT concepts provides alternative descriptions that move the data in a different way.

### *Networks*

The concept of networks has been referred to in many empirical and theoretical ANT studies, and has been related to knowledge and learning: ‘knowledge is generated through the process and effects of these assemblages coming together ... learning itself becomes enacted as a network effect’ (Fenwick and Edwards 2010:4). Nespor’s (2014) study on the networks of physics and management in higher education has been very influential for situating knowledge in space/time, and for developing a terminology to support this by describing the differences between networks of physics and management courses

(Fenwick et al. 2011). Sørensen's (2009) *The Materiality of Learning* is a detailed examination of education practices drawing from ANT. Sørensen describes the research as 'a development from being entangled in one network to becoming entangled in another – a spatial movement rather than a temporal progression' (Sørensen 2009:73).

Although the concept of networks helped to reconceptualise learning and knowledge in new and interesting ways, it also raised a number of issues. I have identified four main points of concern about networks. First, the network is dynamic and conceptual, as opposed to being a fixed and transportable framework. Latour identifies the 'new' use of the term network as having divorced itself from ideas such as rail systems or computer networks. Instead, the word 'network' is used to describe the translations and effects that take place when elements come together (Latour 1999b). The second point is to do with the role of the researcher. As someone who is not participating in the 'world' of the network, I cannot represent the network, either as an insider or an outsider. The third point is related to the second, because in early applications of ANT there was a danger of attempting to represent only the most powerful or visible actors. The last point is that everything the researcher sees is included in the network, at the exclusion of some entities: 'the temptation to collapse all interactions and connections into networks needs to be avoided ... not all relations that contribute to producing these effects will be networks' (Fenwick and Edwards 2012:xviii). In other words, the network becomes everything the researcher considers to be in the network, with other elements being disregarded, which is why the researcher speaking for the world is problematic and why representation is avoided. During my fieldwork, I experienced how I became part of different networks, as connections strengthened through being involved in situations. For example, I was considered part of the project group for the second cohort, as I worked alongside the students at all times.

I therefore draw from the concept of networks whilst considering these potential problems. My research explores SLISPs as situated, practice-based and entwined, from which learning emerges through network effects (Ahn et al. 2015). The main advantages of conceptualising networks are as a way of describing relations between entities rather than the entities themselves, and observing how networks interact through strengthening connections to become more stable or by weakening the forces that hold networks together. Another advantage is to view everything as potentially affecting the network



through forces and relations; the entities themselves are not considered unless they act upon the network (Latour 2005).

### *Symmetry*

As detailed in Chapter 3, symmetry describes how dualisms are challenged in ANT; for example, humans are not foregrounded in favour of non-humans, as commonly happens in sociological theory. As previously described, ANT looks at networks and relations, at associations between entities rather than bounded individual entities. This raises questions about how the researcher (a human) presents non-humans and also about how non-humans participate in the social (McLean and Hassard 2004). An ANT sensibility considers what things *do* rather than what they *are*; what effects elements have within their particular networks and what associations are formed. In terms of how knowledge is conceptualised:

knowing, or coming to know something, is regarded as something that emerges as an *effect* of the socio-material arrangements that gather together and are performed into being through the continual transactions. (Ahn et al. 2015)

In this way ANT is different from other forms of enquiry, as elements of the network only exist as associations with other entities within that network; in another network, they might have different effects and perform different realities. For example, during my fieldwork I observed a student looking at medical notes that had been filled out with a thick, italic pen. Numbers were illegible because of the thickness of the pen and information was obscured. In the second cohort, it was noted that pharmacists use a green pen, so evidence of pharmacists writing notes was plain to see. In both cases, the pen in each network created an effect that would have been different in other networks. For example, the thick, italic pen would have a different effect if it was used for writing a sign: a thicker mark would be more noticeable and more likely to shape actions; and the green pen used by the pharmacist would not have the same associations in a different network. Focusing on the pen itself might not have provided these insights, but understanding what the pen performed within the network, and the practices it then shaped, provided a better understanding of effects and interactions.

### *Multiple Ontologies*

Bleakley (2012) describes ANT as a research practice that challenges conventional evidence in medical education by exploring multiple possibilities rather than a singular meaning. He describes multiple worlds in relation to networks:

ANT is interested primarily not in epistemologies, but in how a phenomenon such as an 'illness' is conceived across differing practices as multiple ontologies (experienced meanings), each meaning generated and suspended within a particular network of effects. How such networks are initiated and developed has significance for rethinking the nature of 'evidence', restoring faith in the value of a good story. (Bleakley 2012:462)

Developing the idea that practice networks produce reality, Law (2004b) suggests that these different realities can be viewed as different worlds. The conditions of possibility that exist within an ontology are shaped by intervention and performance (Mol 1998). By focusing on the 'world' produced by practice, the researcher can appreciate the particular rather than the general, can attune to the relations and practices within it and develop a sensibility within that world (Law 2004b). This is a departure from the idea of a 'singular' reality that is behind most health research. As mentioned earlier, Bleakley (2012) describes multiple ontologies as performing the opposite function to triangulation: instead of focusing different perspectives on a single object, the object is allowed to open out into how it would perform in different worlds and become a multiplicity.

Mol (1998) presents the concept of 'multiple ontologies' to describe how, within the multiple possibilities within a world, choices and decisions are made. If one accepts the idea of multiple worlds, then there needs to be some consideration regarding how these worlds coexist or compete. Alongside the concept of symmetry, where the object/subject, nature/society and human/non-human dichotomies are eschewed, the interactions of multiple worlds draws out difference in new ways. Star (1990) asks '*cui bono?*' or 'who stands to gain?', and Mol (1998) asks, 'what is at stake?' to explore what is excluded when the hierarchy of a situation is flattened by taking privilege away from humans over non-humans, or foregrounding what are perceived as more important actors. In other words, ontological politics is the examination of what is focused on in a situation and

what is ignored. Mol (1998) also distinguishes between plurality and multiplicity. Plurality refers to many things, but multiplicity means the opening up of a thing, so it is between one and many. For example, a single medical form enacts multiple practices, but there are many medical forms on the ward. Fenwick et al. (2011) put forward the possible implications of considering multiple worlds as presenting questions regarding how worlds are conceptualised and treated.

By drawing from the concept of multiple worlds it was possible to trace how different practices interrelated, and how different associations of the same entity produced different effects. This is relevant to the study of improvement science practices in SLISPs in relation to medical practices such as antimicrobial prescribing and insulin recording. Rather than referring to the practices as different contexts for SLISPs, the concept of multiple worlds allows for these boundaries to be challenged and broken down, and to consider a more relational, ecological view where practices are enmeshed, situated and contingent. This was achieved in this research through exploring difference and ambiguity, which would sometimes signpost to a multiple; for example, Mol (2002) describes how atherosclerosis is performed into being in multiple ways, rather than existing a reified, singular condition.

### **Ethnography and praxiography**

There are many other ways in which this research project could have been carried out, each carrying a set of assumptions and a defined scope. It would have been possible to conduct an ethnography on SLISPs without drawing from ANT, and this would still provide insights into learning. With more recent developments in the field of ethnography, the researcher is now required to consider a more participatory role and to shift the balance of power to the communities they observe, which would have allowed for the type of ethnography carried out in this study (Angrosino 2007). Angrosino and Rosenberg (2011) also challenge the classic tradition of data gathering through observation. For example, traditional methods strived to standardise data gathering and sampling, whereas more contemporary approaches challenge assumptions of truth and the relationship between the researcher and the researched. They also point out the technological advances that widen the scope of observation and data collection. However, ANT was considered to be intrinsic to the project. The fieldwork was planned and designed with ANT, and then drawn through in the analysis. The effect of this was

to attune to and notice mundane details of fine-grained practice as SLISPs were carried out (Fenwick and Edwards 2010). More accurately, a praxiographic approach was followed, whereby ambiguities were explored rather than explained (Mol 2002). As with many ANT studies, this level of detail was best served by a case-study approach (Flyvbjerg 2011; Kanger 2017; Stake 2013). Besides following case study, ethnography and praxiography, there is no set method or framework to follow for an ANT study. Adams and Thompson (2016) have published a set of heuristics that relate to post-humanism and ANT-related studies. These consist of questions to ask at various stages of research, but are designed to guide rather than instruct. The detail that is required for an ANT study means that a very small part of the picture is blown up and investigated in detail. ANT is non-representational (Latour 2005), and therefore not a suitable approach to make generalisations.

### **Rigour and validity in ANT**

Qualitative research methods usually result in amassing large amounts of data, such as tens of thousands of words from interview transcripts, fieldnotes, reflective notes, photographs and documents (Anzul et al. 1991; Punch 2012). The researcher is required to make decisions as to what data is relevant to the research questions, and to undertake processes to present this (Anzul et al. 1991). Developing an analysis strategy from ANT requires the researcher to not only make sense of the data and to be reflexive in their approach to this, but also to interrupt patterns and meaning to hold ideas open. The emphasis is on enactment rather than essentialism; in other words, ‘ANT focuses not on what texts and other objects *mean*, but on what they *do*’ (Fenwick et al. 2011, original emphasis). In this study the emphasis is on *doing* and describing, rather than on representing the data to draw out its meaning. When interviews are carried out, many approaches seek to interpret the meaning behind words. However, Latour (2005:49) warns against seeking meaning in an ANT analysis:

When a criminal says, “It is not my fault, I had bad parents”, should we say that “society made her a criminal” or that “she is trying to escape her own personal culpability by diluting it in the anonymity of society” ... the criminal said nothing of the sort. She simply said “I had bad parents”.

In relation to ethnographic approaches, Latour and Woolgar (2013) borrow from Harris (1976) the idea of validation through etic and emic approaches. Etic approaches involve using a theory to deduce phenomenon and carrying out empirical research to 'prove' the theory; in this case, validation comes from fellow researchers through categorisation and generalisation. Emic approaches require a longer period for observation, to allow for insights to emerge, which are validated by the participants themselves. In my analysis, an emic approach was followed as it is important that participants validate the research and that insights come from within rather than being imposed by the researcher. This requires careful consideration of what is knowable in a situation, as the ontological position of ANT is not to discover a pre-existing truth but to allow participants to describe their own reality rather than being represented by the researcher. This position is different to the materialisms of, for example, Marx and Engels, which relied upon knowing 'real' people as they 'really are' (Harris 1976:330). For ANT, participants are considered as assemblages of human and non-human entities whose realities are contingent to the networks they are connected to and the worlds they reside in.

With these analytic preferences stated, it should be noted that many researchers have encountered methodological problems in ANT studies. For example, Nespor (2014) describes, at the end of his account of knowledge and learning in physics and management programmes, how he reconciled the outcomes of his research with what he intended at the outset. He describes the compromises he had to make during the analysis process:

I gave up some of the mobility, stability, and combinality of the interview discourse by reproducing it in lengthy, relatively immobile chunks that are unstable (in the sense that they allow alternative explications), and mix poorly because they are uncoded. (Nespor 2014:153)

Nespor (2014) goes on to say that he expected some degree of reductionism, because there are multiple perspectives that will be mapped over each other to produce a single explanation of what it all means.

I employed ethnographic methods in my research to investigate knowledge and learning through networks, following Latour and Woolgar (2013), Nespore (2014), Mol (2002) and Law (2004b). As these authors point out, ethnographic methods originate from the study of people and culture; a sensibility of relations, materialities and networks need to be taken into account for ANT. Bleakley (2014) also points out that an ANT ethnography requires ‘special qualities’ of the researcher to notice and attend closely to detail. Attending to detail enables a more critical examination that can challenge assumptions and uncover practices that may be less visible or less valued (Law 2004b).

In many research methods there is a framework to test against or a set of steps to provide guidance, and some are more directive than others. For example, CHAT has a series of stages: model the situation, produce an activity system, decompose this, generate research questions, conduct the investigation, interpret the findings; there is also another system for analysis and the triangle model (Engeström 2001). In critical discourse analysis, the framework produced by Fairclough can be used to analyse the texts and provides a series of stages (Fairclough 2003). ANT is not conducive to frameworks that might impose external or theoretical meaning onto a situation. As Latour wrote in a fictional dialogue with a student who was insistent about ‘using’ ANT as a ‘framework’:

“My Kingdom for a frame!” Very moving; I think I understand your desperation. But no, ANT is pretty useless for that. Its main tenet is that the actors themselves make everything, including their own frames, their own theories, their own contexts, their own metaphysics, even their own ontologies. So the direction to follow would be more descriptions I am afraid. (Latour 2005:147)

Despite this, Bleakley (2011) refers to ANT as a framework, and a recent paper (Kanger 2017) also puts forward ANT as a framework. In a similar way, the debate about ANT as a theory has been played out in many discussions (Latour 1999b; Law and Hassard 1999; Mol 2010). Adams and Thompson’s (2016) set of heuristics are intended as guidance, where not all of them need to be applied, rather than a set of stages to follow in sequence. It would have been incongruent with an ANT approach to apply a rigid template, model or series of steps to be followed. As Law and Singleton (2003) found when they attempted to produce a formatted ‘process diagram’, practices do not always

conform to such treatment, and such handling can lead to a reductive representation of the data. In the absence of a framework or a set of steps, I needed to demonstrate validity and rigour in a different way by forming my own process of analysis.

### **A dancer's aside**

*During my PhD I worked as a dance instructor. My experience of dance helped to shape my approach to the research. Initially, the styles of dance I practiced (Modern Egyptian and Raqs Sharki) helped me to conceptualise different approaches in research. Commitment to a particular style does not necessarily exclude certain movements that belong to other styles, but there is a need to develop the knowledge of specific styles to know what is congruent and what is not. This is similar to research approaches, in that 'bricolage' allows for different perspectives to come together (Kincheloe et al. 2011), but a knowledge of the ontological roots of different approaches allows the researcher to identify if there is a 'clash'. As Lincoln et al. (2011) argue, some paradigms are commensurable, but not where axioms are contradictory and exclusive, for example, positivist and interpretivist models. In my research I felt the convergent trajectory of coding and categorising, as I had done in the past with grounded theory and Critical Discourse Analysis, was not congruent with the divergent trajectory of ANT. However, this raised its own set of problems. Divergence and difference require an opening out of an already complex set of scenarios, potentially creating inflation and increasing complexity.*

*This brings me to the second area in which my dance experience came to be helpful. In choreography, the dancer can interpret complex musical pieces but without reducing or increasing the complexity. The dancer 'moves' the music to see it in another way, and presents bodily moves that accentuate some parts of the music but not all. The drum solo in Arabic dance is a good example of this. The dancer does not move a body part to every single beat; some parts of the music are better represented by a pause or by a surprising move that makes the dance interesting but still in keeping with the music. Even so, the dancer considers the whole of the piece and aims to dance in a way that adds to the music, i.e., not too simple and repetitious, but also not too busy. In relation to my research, I was not attempting to present an account of my entire research, but to draw out parts that resonated; in this way I could consider all of my data, but not try to put a value on talking about some parts and not others.*

*Thinking of my analysis in the same way as dance offers me, as a researcher, a way of maintaining complexity without reducing it: 'when we look at dance, we see opportunities for movement, we see obstacles, limitations. We see the world, but we see it as a world-for-movement, that is, the world as a domain for action' (Gehm et al. 2015:125). In my analysis I have drawn on the experience of building a choreography as a way of maintaining complexity.*



## 4.2 Fieldwork

### Preparation for fieldwork

At the start of my PhD, my supervisor had been appointed onto the panel of the Scottish Improvement Science Collaborating Centre (SISCC) and was able to put me in touch with a contact to enable me to access research student-led improvement science projects (SLISPs). To extend my knowledge, I attended meetings and conferences to get to know some of the key contacts and to hear about SLISPs. For example, in October 2014, I attended a People Risk conference to hear about improvement science and patient safety concepts adopted from different disciplines. In November 2014, I participated in a workshop on Teamworking to Improve Healthcare, and met with students who had completed SLISPs. I also attended SISCC meetings and workshops and was invited to participate in an online Delphi study related to improvement science practices. I also regularly attended and presented at a special interest group at the Nursing, Midwifery and Allied Health Professionals Research Unit meetings at the University of Stirling. This preparation helped me to assess whether SLISPs would be a suitable area to study practice learning in the workplace, and to ensure ANT would be a suitable approach.

I met with my first key contact (Tel) at a meeting with the SISCC group which I was invited to by my supervisor. A meeting was set up with myself, Tel and Cal in July 2015. Both contacts were highly supportive and helpful in the organisation of my research, and remained so for the duration. Their support was critical throughout my fieldwork in putting forward and allowing access to suitable candidates, and for the continued access to NHS staff and premises. I had an informal, preliminary meeting with a medical student, Chris, in June 2015, where we discussed what I was aiming to achieve during my fieldwork. I also learned more about SLISPs and what I could expect in having these as a focus for my case studies. Chris had already carried out SLISPs, both leading and as part of a team. From this, I could gauge if my research plans were viable and realistic in the context of SLISPs and in a hospital setting. I had already gained project approval at my Annual Progress Review in 2015, and so began the ethics process.

### *Ethics*

I was granted ethical approval from the School of Education at the University of Stirling on the 22<sup>nd</sup> September 2015. For NHS approval, I completed the Health Research

Authority diagnostic tool for 'Is my study research?' online. The outcome was that the HRA did not consider my study to be research in the clinical sense, and therefore I did not need approval. I had this confirmed as a definitive answer by the Scientific Officer and Manager at the East of Scotland Research Ethics Service at Tayside Medical Science Centre. Although the outcome was straightforward, the process of clearing ethics approval with the NHS was confusing and protracted. After I received confirmation that I did not need ethics approval, I was asked to clarify how I would assure patient confidentiality by the consultant on Ward 1. I demonstrated this by accessing and printing the NHS Code of Conduct. I also added that I had completed an online NHS module on data security whilst I was an employee of the NHS. The consultant was satisfied with this measure, and advised me to add this information to my information form. This was sufficient for me to start observing on the wards.

### **Confidentiality**

As part of the ethics approval process I was required to assure confidentiality and anonymity for all participants (Appendix 1). When I first started to write my analysis, I referred to people using numbers and locations using letters. This sounded impersonal and detached, so I drew up the following 'legend' of pseudonyms (below). I did not want to distinguish attributes of individuals so I allocated gender-neutral, and where possible, culturally indistinct, pseudonyms.

### **Participants**

Cohort 1, Student (medical) 1: Chris

Student (medical) 2: Sandy (not assigned to a cohort as their project could not be observed)

Cohort 2, Student (medical) 3: Lee

Cohort 2, Student (pharmacy) 4: Taylor

Cohort 2, Student (pharmacy) 5: Alex

Contact 1: Tel

Key Person 1: Mac

Key Person 2: Jean

Key Person 3: Charlie

Key Person 4: Cal

## **Locations**

Simford Hospital

University of Simford

Hanton University

Wards 1, 2, 3 and 4

### *Cases: Cohorts 1 and 2*

I planned to conduct two case studies, referred to as Cohort 1 and Cohort 2. A case study approach allowed for sufficient depth and detail (Flyvbjerg 2011) in the data to support an overarching ANT methodology. I planned the cases based on the ‘quintain’ model used in multiple case studies (Figure 4.1) (Stake 2013). The quintain model helps to consider the boundaries of a case by acknowledging different aspects such as history, setting, policy drivers and previous research. It also begins to assemble the case by situating the student and the SLISP as the focus of study, rather than focusing solely on the student. This is useful when studying more than one case because similar considerations can be made. I considered the approach to be congruent with ANT as the case became an assemblage of inter-related components rather than focusing on the student or a single actor. Although my research design did not meet the exact criteria of a multiple case study approach as set out by Stake (2013), who recommends this approach for five case studies or more, I found it useful to employ this model for planning. I had originally proposed looking at more cases, but, because I wanted to explore detail and nuance, it was not practical to look at more than two cases. The rationale for two cases was firstly strategic: if one case did not seem to yield enough, or if the case was withdrawn for some reason, then there would be another for contingency. It was not the intention to ‘compare and contrast’ or to attempt to generalise the outcomes for other SLISPs. However, I found there were unexpected advantages to the research to have more than one case. The main advantage was that it helped to avoid getting too drawn into the SLISP itself and the area of investigation. I found the project topics fascinating, and could see how I might explore the practices directly involved (i.e., antimicrobial stewardship, medical reconciliation, and so on). I found that my focus became more clearly defined throughout the fieldwork period (Ragin and Becker 1992).

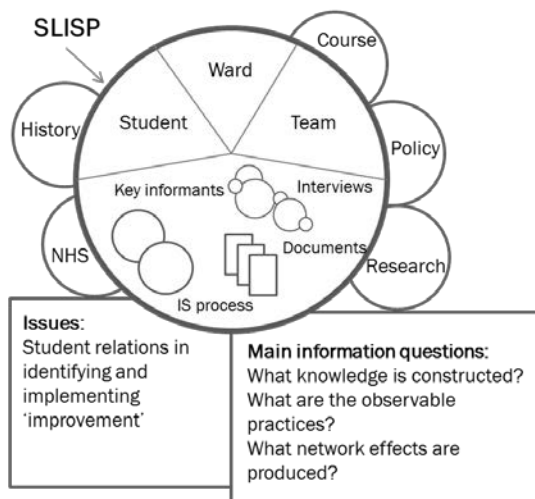


Figure 4.1: The case quintain

### Entering the field

My research took place within Simford Hospital,<sup>8</sup> which is located in Scotland and is one of many hospitals serving its NHS board. I was mainly based in one block in the hospital and medical school. The medical school is part of the University of Simford and all the medical students were enrolled there. The other students were pharmacy students from Hanton University.

Before starting the fieldwork with the cohorts, I recorded my own observations of some of the spaces within the hospital. Latour (2005) suggests making lists and keeping different journals for notes relating to different aspects of the research, such as reflections of the researcher. This is for the purpose of making detailed descriptions in the field, which is critical for an ANT investigation. I recorded notes by hand in a spiral-bound, A5 notebook with a margin. I sometimes used the margin to annotate my notes, or sometimes used a pen with a different colour of ink. The materiality of my fieldwork data collection greatly impacted on what I recorded. I invested in a keyboard for my iPad so that I could record additional notes onto Evernote. I have used Evernote throughout my PhD, and I now have an extensive record of my rationale, reasoning and reflections throughout the whole fieldwork process. I recorded 88 notes from the 1<sup>st</sup> June 2015 to 7<sup>th</sup> November 2016. It is problematic to separate these notes as ‘reflections’, as these are

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<sup>8</sup> From this point, all participants and locations are referred to by the pseudonyms on page 74.

also the start of my analysis through thinking and writing (Crang 2003). The healthcare sector has a tradition of encouraging reflection as a learning technique but, as Fenwick (2014a) warns, this approach assumes that thinking through reflection is separate to doing in practice. My ontological position viewed reflection as entangled with other research activities. However, I do refer to reflection in the notes as a way of indicating that these notes were made after observations and interviews.

It would be easy to exclude or demote my notes on Evernote as these were not a record of what I saw and heard but of what I felt and reacted, which I considered to be an important part of the research process. However, these notes can lead to surprising connections and insights into the data (Crang, 2003). Punch (2012) draws extensively from a reflective diary in her experiences of conducting an ethnography in Bolivia. She describes these as an intrinsic part of fieldwork that can sometimes be made invisible in ethnographies. I also used Evernote to record things I could not write down at the time:

Evernote reflections 21<sup>st</sup> October 2015:

Reflecting on the observation yesterday, there were a couple of things I didn't write down (I didn't want anyone to see!) These were the story about the SR [Specialist Registrar] who asked me if I was a medical student and I said no ... Later [Chris] said we had to hide because they'd be on the look-out for students to take samples, so that might've been why he asked.

As the above extract shows, keeping separate notes was sometimes necessary, as it would sometimes have been inappropriate or insensitive to share my thoughts with staff who were not familiar with my study. In this example, there was a practical reason for writing notes after the event. The Specialist Registrar, mentioned in the extract, had asked me if I was a medical student and I was puzzled by the reason for his question. I responded by telling him that I was a social science researcher and asked if he wanted me to leave; I was observing a ward round with a crowd of clinical staff and assumed I was in the way. The Registrar was happy for me to stay and made it clear that this was not the reason for the question. It was only after the incident that the student I was observing, Chris, told me that it was common on ward round to be asked to participate by, for example, taking

blood samples. This was considered to be an opportunity for medical students to gain experience. Chris had suggested that we ‘hide’ to avoid being asked to participate as we were observing other activities. The example also highlights my participation as an observer and the way my presence created network effects; I was entangled in the situation. As Barad (2007) would say, I was intra-acting as a co-producer of reality rather than inter-acting without producing effects.

Hamersley (1993) described making notes away from the situation when it felt inappropriate to write in front of participants, and how he made frequent excuses to go to the toilet to do this. Fox (1990) detailed his embarrassment when a participant forcefully took his notes during an observation and ridiculed the notes in front of other participants. These examples illustrate the potential difficulties with making notes in the field, and how the researcher needs to use their discretion to decide the potential impact of this. My Evernote notes helped me to record and recall the detail of specific situations very soon after they occurred. The process of making notes before and after observations was very useful to me in the field. Evernote helped me to debrief after spending time at the hospital, and also provided a journal record as the fieldwork progressed.

### **Cohort 1 SLISP: antimicrobial prescribing**

I began my fieldwork by formally interviewing Chris. The purpose of the interview was to gain a better understanding of SLISPs and Chris’s project in particular. I anticipated that this would help me to plan the observations and ethnography, to make the best use of time on the hospital wards. The initial interview helped to build trust with Chris and enabled me to become more familiar with what the student would be attending to as they carried out work for their SLISP. I made the decision to fully transcribe all my interviews. My decision was based on past experience of partial transcriptions, which I felt were not adequate for the kind of analysis I was applying; in order to transcribe only ‘relevant’ sections, I had to first decide what was ‘relevant’ and I needed to be very familiar with my data before I could do this. I fully transcribed the recordings in terms of typing every word, but without including pauses, emphasis, gestures and so on, as might be carried out in conversation analysis. I typed the transcriptions onto a word document and printed off hard copies. I experimented with methods to analyse the interviews as I wanted to connect the interviews to the fieldwork and to the examples I used in the analysis. I used post-it notes on the hard copies to indicate information that I referred to in the analysis.

I also used the ‘Track Changes’ function in Word to mark the documents electronically; I found that it was easier to analyse the transcripts electronically as it was easier to search the documents. I used the ‘Comments’ function to annotate the transcripts and to highlight sections that linked to the fieldwork. I also experimented with mind-mapping to analyse the interview recordings (Appendix 4).

Chris’s SLISP was about antimicrobial prescribing as part of a wider Master’s project in quality improvement (see Chapter 2, page 36). Chris and the SLISP became my first case, which I refer to as Cohort 1 (Figure 4.2). I accompanied Chris to investigate the most suitable wards for study, and met with consultants and other staff to discuss how the study would be carried out. Chris decided to conduct the SLISP in two wards: Ward 1 and Ward 2. After the wards were selected I conducted my own observations without Chris, to attune to the environment. I carried out observations on Ward 1 on my own, but on one occasion I was turned away from Ward 2 as the senior charge nurse felt the ward was too busy at the time. I found that my presence was more accepted when I accompanied Chris than when I was alone. However, my solo observations on Ward 1 proved to be very illuminating and important for the study. I also accompanied Chris to observe meetings and events such as the ‘Ideas Laboratory’ that was part of the drive to promote research and improvement methods.

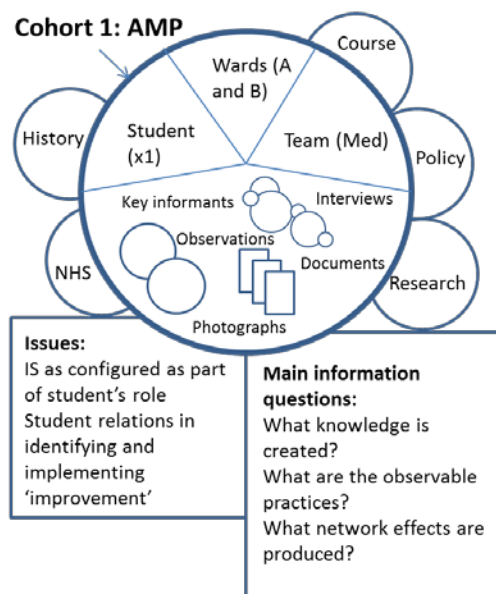


Figure 4.2: Cohort 1 quintain – antimicrobial prescribing (AMP)

The different working environments I observed were helpful to get a wider sense of what the SLISPs entailed. Of particular interest were the hospital wards where Chris carried out data collection. As previously mentioned, Chris selected two wards that were quite different in set-up. Ward 1 is a long corridor with side rooms leading off. There are no bays, so patients are rarely visible from the corridor. Apart from the reception, all the side rooms, offices and meeting spaces have doors. Ward 1 is the most self-contained of all the wards studied, and for periods during my observations, staff were working in the side rooms and the corridor was quiet and empty. At other times, the corridor was very busy. The doctor's office is towards one end of the corridor. Foundation Year doctors (FYs) rotate every few months on this ward. This was the only ward where I was granted permission to take photographs; the main concern was protecting patients and patient information.

Ward 2 is a surgical ward, situated on one of two surgical floors. Its layout is very similar to all the other surgical wards (Figure 4.3). In this ward, there are bays as well as side rooms, so patients are more visible. The structure is designed in a square, with bays and offices on four sides and a corridor leading all the way around. This ward is more open than Ward 1, with patients and staff more visible. FYs rotate every few months on this ward, and the resident pharmacist participates in the ward rounds.

I conducted observations with Chris mainly on Wards 1 and 2. I also 'lurked' around Ward 1 and spent more time observing with my student in Ward 1, because it was possible for the student to conduct their project work without being near staff or patients. It was more problematic to lurk and spend time in Ward 2 because staff and patients were constantly moving around. Both myself and Chris had to be sensitive to working practices on the ward and not get 'in the way'.



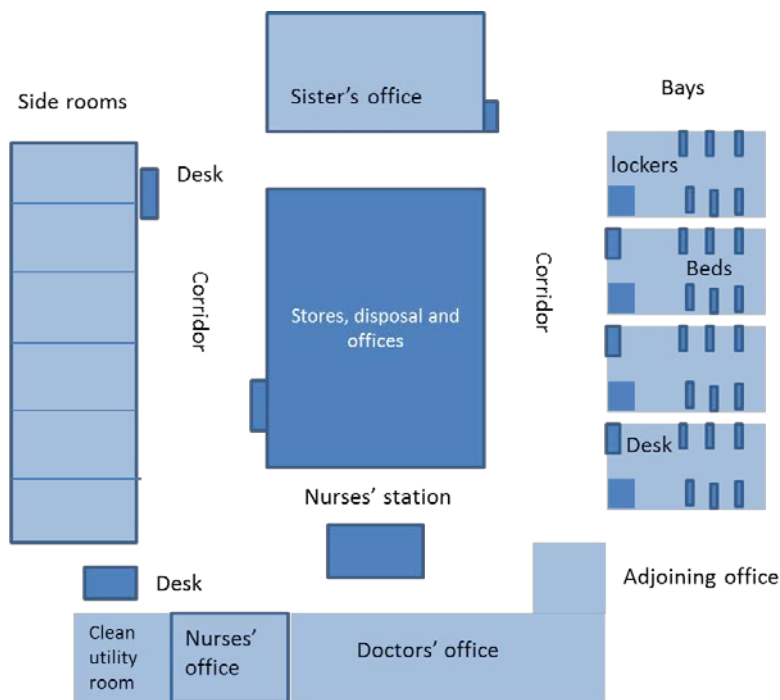


Figure 4.3: Standard layout of wards 2, 3, and 4

I spent a total of 33.5 hours of observations with Cohort 1. This broke down to 19 hours of direct observation with Chris on the wards, 4.5 hours of solo observations of the wards, and 10 hours of observations outside the wards. I carried out two interviews with the student, one meeting, and three interviews with key contacts identified by the student. I collected documents and took photographs (Table 1). To research Chris's subject, I completed the first part of a Massive Open Online Course (MOOC) on antimicrobial stewardship.<sup>9</sup>

### **Cohort 2 SLISP: insulin recording**

The second case was a SLISP project undertaken by a group, comprising a medical student from the University of Simford (Lee), and two pharmacy students from Hanton University (Taylor and Alex). Lee was conducting the project as a Student Selected Component. Taylor and Alex were completing the project for their dissertation, as described in Chapter 2, page 43. The focus of the SLISP project was improving medical reconciliation for insulin-dependent patients (Figure 4.4, Table 1). Because this was a specific IHI Practicum project, the timescale for this was exactly four weeks from start

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<sup>9</sup> <https://www.futurelearn.com/courses/antimicrobial-stewardship>

to submission (from 16<sup>th</sup> November until 11<sup>th</sup> December 2015). Because Taylor and Alex were commuting each day, their attendance would be restricted to these dates. This meant that it was not possible for me to have an informal meeting with the students prior to joining them at the start of the project. I made the decision, through discussion with my supervisors, to include all three students rather than to ‘pick’ one student and to review this as the project progressed. My rationale was that it might be awkward to focus on one student when the three students were working together on the project. I was also conscious of the short timescale; the project was for four weeks in total, so the students would need to be focused on their project for the time they were together, and having a researcher asking questions of only one of the students might inconvenience them and put them at a disadvantage. My decision to work with all three students meant that I could keep closer to the practices of the project and use my discretion as to what I was observing and who I was speaking to.

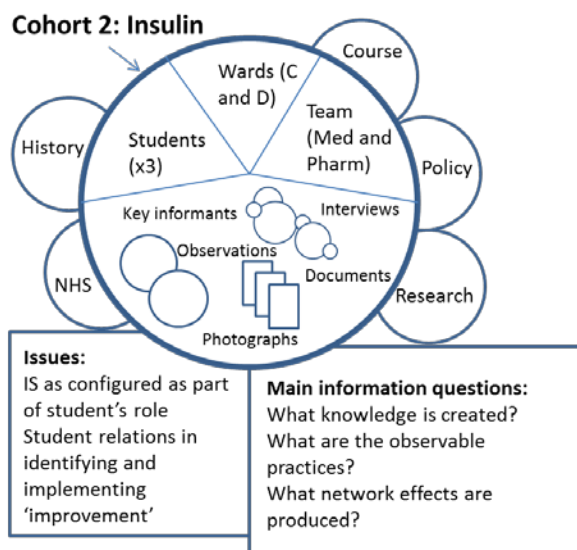


Figure 4.4: Cohort 2 quintain – insulin recording

At the start, the students had a discussion with their allocated clinical team about where to situate their study. They decided on Wards 3 and 4, two other surgical wards which had a similar structure to Ward 2 (Figure 4.3). Ward 3 is very similar to Ward 2 in terms of working practices. Ward 4 is slightly different in that it is busier, and the rotation of Foundation Year doctors is much more rapid (a few days as opposed to a few months). This had consequences for the project, as staff engagement, opinion and ‘buy-in’ was critical to the uptake of the improvement. This was particularly true for FYs as they

would be more likely to fill out the medical reconciliation forms that the students were proposing to change.

My work with Cohort 2 involved being with the group as they visited wards and also carried out their project in other spaces. I completed 57 hours of observation with the group, but only 14 hours of observation took place on the wards. This was because the wards were busy and open, and we needed to be sensitive to working staff. I decided whether to accompany students on the wards based on whether I thought I might get in the way and hinder the project. I also respected the wishes of the group when they suggested visiting the wards alone or in smaller numbers, being mindful of the impact we might have on the ward. The group spent time on the project in other spaces such as the rest area, teaching rooms, the computer room at the library, pharmacy offices, the Innovation Centre and the locker room.

I interviewed the students as a group initially, then individually. It was difficult to allocate time towards interviews, as time on the project was limited. The initial group meeting was opportunistic as I had been unable to fix a time to interview the students separately. The students had little time to get to know each other and to decide how they would carry out the project, and I exercised my discretion as a researcher to ensure their needs were prioritised. Later in the project I was able to interview the students individually. After the project had finished, I interviewed another key contact who was named by the students. The group set up an online chat facility, which they agreed I could include in my research. This proved to be very useful for tracking dates of particular incidents during the project. I also took photographs and collected documents. The documents I collected for both cohorts were blank medical forms and documents relating to the SLISP projects. The photographs I took with Cohort 1 were noticeably different from the photographs in Cohort 2. In Cohort 1, I was given permission to photograph Ward 1 as, being in side rooms, the patients could not be seen. I ensured any identifying information was blanked out. In Cohort 2, I took pictures of practices outside the ward, for example handling forms in the rest area and in the locker room. I later made collages of the two cohorts, and the different content of the photographs created contrasting images (Appendix 2). As mentioned earlier, the cohorts were not intended to be compared, but it was interesting to see how the configuration of the photographs gave each cohort a different character.

Table 1: Sources of data

	<b>Cohort 1</b>	<b>Cohort 2</b>
<b>Observations (collected in handwritten fieldnotes)</b>	Wards 1 and 2; solo observations on Ward 1. Ideas Lab meetings in the Innovation Centre.	Wards 3 and 4. Teaching rooms, meeting areas, locker room, corridors and pharmacy office.
<b>Interviews (all fully transcribed)</b>	Chris (two interviews and a meeting) and Sandy; Key Contacts Mac, Jean and Charlie.	Group interview with all students. Individual interviews with all students. Telephone interview with Cal.
<b>Reflective notes</b>	Evernote	Evernote
<b>Documents</b>	Blank clinical forms; student collection forms; protocols and guides; photographs of Wards 1 and 2, and the Innovation Centre.	Blank clinical forms; student collection forms; PDSA formative and summative forms; photographs of student project work.
<b>Other sources</b>		Slack (social network group), Google Docs.

### Attuning to the hospital environment

My early notes capture the feelings I had of being in the hospital. This helped me to reflect on my role as a researcher and to position myself in the working environment. Starting the observations on my own also helped me to make decisions on where to record notes. I used handwritten notes during observations, and typed reflective notes into Evernote, sometimes when I was travelling home on the train. In one account of a solo observation, a nurse from a different ward comes in and I realise for the first time that even people who work in the hospital can feel out of place, as I did:

Fieldnotes from solo observation, 5<sup>th</sup> October 2015:

A visiting nurse doesn't realise she's in the way, apologises, and dashes out of the way for the bed to get past. I'm glad I'm not the only one!

At the start of my fieldwork, my greatest worry was being in the way. It was comforting to realise that everyone is in the way at some point, and has moments of awkwardness even if they have a lot of experience in that environment. There are several instances of feeling in the way throughout Cohorts 1 and 2. This started to flag up the connectedness of practices and the strength of existing networks which is discussed in Chapter 6.

I also recorded how the corridors of Ward 1 become busy and quiet, and the effect of all the patients being in side rooms:

Fieldnotes from solo observation, 5th October 2015:

At one point, there are lots of people in the corridor, then they are all gone, just like that. The side rooms give the effect of bursts of activity – movement, sound and talk.

At the early stages, it was difficult to know what to attend to, what to sensitise to. It is difficult to analyse this part of my fieldwork, as the SLISP component is not yet at play. However, observing solo allowed me to look at things without understanding the meaning; the notes meant nothing to me.

I also made a note in my reflections about not taking notes when my student was talking to people:

Fieldnotes from observation with Chris, 23<sup>rd</sup> September 2015:

I was a bit overwhelmed ... I found it difficult to write notes in the beginning because we were walking around and I didn't want to bump into things. I was also trying to pay attention to what was going on, so I didn't take notes whilst [Chris] was speaking to staff.

This is another example of intra-action (Barad 2007) and of being conscious of making connections. It was also an example of how I began to attune to the environment during the fieldwork. From an ethical perspective, I was conscious of the effect of my presence and how this might impact on the SLISP. I constantly had to think about my position and how this affected the project; the Evernote notes helped me to do this.

## **Different types of data**

Throughout my fieldwork, I took notes, collected documents, took photographs and drew diagrams. I recorded interviews and transcribed these. I had planned to collect information in this way, but there were some adjustments that I made as I went along, and I also included some sources that I had not anticipated such as the Slack social media group. I revised my processes from Cohort 1 and applied these to Cohort 2. There were some differences between the two cohorts which meant that the information I collected was different, and therefore my analysis would also be adjusted.

I found the quintain to be a useful way of revising my researcher position in relation to the two cases I was studying. Initially, I found I was becoming entangled in the SLISPs that students were undertaking as I carried out observations. By conducting two cases I was able to focus more on my own research questions. However, the quintain presents the assumption that the boundaries around each case are knowable, but in practice there are a great deal of assumptions (Hassard et al. 2012). For example, one of the dimensions of each case was time: Cohort 1 was undertaking a longer-term study which I was only studying part of, whereas Cohort 2 had a clear timebound demarcation, with the group only being together for exactly four weeks. Also, there was the effect my increasing familiarity with some aspects of the hospital over time. Drawing from an example from dance, when action is being observed in an environment (in this case a hospital ward), the observer relies on their perceptions to become acquainted with the environment; in other words, it is difficult to understand what is going on until things become more familiar (Gehm et al. 2015).

## *Text*

I recorded fieldnotes by hand in a spiral bound notebook. I annotated the notes with a pen with ink of a different colour and marked different days and incidents with post-it notes. At first I carried two notebooks with me: one for notes with the student and one for my own notes. However, I used my iPad and keyboard to make notes with Evernote, and this became my way of recording reflections. By the end of my fieldwork I had two notebooks for each cohort and reflective notes on Evernote. I conducted my analysis of the fieldnotes in stages. At first, I read through them and followed particular incidents to become more familiar with what I had recorded. I then decided to scan the notes into PDF files. I did this twice, first with a separate file for each observation or meeting, so

that I could hyperlink these individually to my fieldwork log. I then made PDF files of the whole books. This allowed me to annotate each book and to be able to search the whole of the book (Appendix 4). Although I ended up with the same information in three places (hard copy, separate electronic files and files of entire books), this allowed me to navigate through each observation separately, and also to search whole books to trace devices or incidents.

As described earlier, I transcribed all of my recordings. Doing this allowed me to trace incidents and devices. I annotated the hard-copies and used post-its to indicate places of relevance. For some transcripts, I annotated notes electronically. It seemed appropriate to use different methods as the interviews themselves were different. The interview analysis summary helped me to keep track of all of the interviews. I compiled my reflective notes from Evernote into Word documents in date order. This gave me a chronology of the reflections. I also made hyperlinks to individual reflections on the fieldwork log to ensure the reflections were connected to the appropriate observations and interviews. For Cohort 2, I found that the written information extended to social media. I sought permission from the students to include this in my analysis, as I found this to be useful. The Slack group, for example, was a message board for everyone in the project to keep in touch. By the end of the fieldwork, the Slack group provided a chronology of incidents that I could compare to the notes I had taken.

### *Documents*

I was permitted to take away blank medical forms from the wards. These were useful to clarify what was being recorded on the forms that my students were looking at. For example, the prescription chart (Kardex) featured prominently for Cohort 1, and contained information such as codes to indicate how the boxes should be filled out. I was given a blank prescription chart for gentamycin, which printed with a red bar and a sticky strip to be attached to the prescription chart. The (pink) insulin forms, including the Insulin Prescription and Diabetes Monitoring Record and the Intravenous Insulin Management Guideline (referred to as the 'sliding scale'), were relevant to Cohort 2's SLISP. The admissions form with the medical reconciliation chart was also useful to look at for both cohorts. I also accessed forms and protocols online from the Formulary. The forms contained detailed information regarding how they are to be completed, and it was useful to be able to read these in detail away from the wards. I was able to photograph

the forms as they were used in practice, with the students putting stickers onto blank forms. For Cohort 2, I collected the IHI Open School Practicum documents as they were used: these included the cause and effect, or Fishbone, diagram; the process diagram; PDSA cycles; and the reporting forms (Appendix 3). These were useful records of the students' project as it progressed.

### *Visual*

I experimented with the photographs that I had taken as I continued to analyse the data. At first, I isolated images of some of the materials involved in SLISPs, and mapped these into a 'narrative pathway'. This helped me to attune to connections and associations. The diagrams I then used visual methods to compile the images from each cohort into a photomontage (Appendix 2). Latour and Woolgar (2013) used photomontages in *Laboratory Life*, and visual methods can contribute greatly to analysis (Prosser 2011). I used these images to help me notice details of each project. Another method of visual analysis I used was by using the 'remove background' function on PowerPoint. This isolated parts of the picture through contrast and brightness; but instead of separating objects and people, the function selected parts of different objects. The images helped me to conceptualise elements of practice as being stuck together (Fenwick et al. 2011) rather than reduced and compartmentalised into separate objects and people. The process challenged conventional boundaries and prompted me to think about how materials assemble and operate together. Writing descriptions of the data enabled me to analyse situations and to think about the way I articulated workplace practices. The process of de-centring the human in ANT accounts is problematic as language is a human endeavour and objects cannot communicate. Bruni (2005) wrote of a hospital electronic patient record (EPR) system from with the notion of a non-human ethnography. Law and Singleton (2003) described how a process model they had been constructing did not relate to the systems they had observed, and instead described the process through narrative. I used both writing descriptions and constructing images to help with the analysis.

I experimented with collage techniques and animating images on PowerPoint to help me to conceptualise networks, and also to allow my analysis to symmetrically consider humans and non-humans. This also helped me to articulate my treatment of elements as associative, situated, interconnected and dynamic. Benjamin's (1999) concepts of conjunction and decontextualization, taking seemingly mundane information and putting



it in a different context, highlights new connections and insights. Benjamin (1999) embraced the differences that researchers might detect in the same information rather than trying to 'remove bias' and homogenise the data. Rather than think of analysis as producing something final, it is a 'momentary pause in an endless flow' (Crang 2003:135). Collage can be seen as disrupting linear arguments in restrictive, linear writing. I found that experimenting with images to produce collages and montages helped me to analyse the data I had collected in a non-linear way that was appropriate for ANT. The idea of montage and collage is aligned with the divergent nature of my analysis and facilitates the opening of data rather than converging and grouping. Collage also helps to think of entities as channels of forces and action rather than metaphysical 'things' with inherent properties. Entities can be conceptualised as conduits of learning, as nodes in the network where knowledge gathers. By considering the texture of practice (Fenwick and Landri 2012), we sensitise to the feel, smell, sound and noise of it. The visual images are explored further in relation to the ANT dimensions later in this chapter.

### *Audio*

Throughout my analysis I listened back to some of the recordings and drew concept maps or followed the transcripts alongside listening. This repeated exposure to my data helped me to think of ways to analyse specific incidents, and also to consider what I was not including in my analysis.

### **Combining the data**

I needed to consider the whole of the data I had collected and make decisions on which parts to focus on. I therefore started by taking stock of all the data I had collected. I drew up a table, or 'Fieldwork Log' (Figure 4.5), where I recorded the date, time, location and comments for each activity that I undertook, such as observations, interviews and attending meetings. For each entry, I added a hyperlink to the transcript, fieldwork scan, reflective notes, and anything associated with that activity. I drew up a list of documents and photographs for each cohort and added hyperlinks to these. I also included screen grabs of the social media sites that were referred to. This provided me with a record of what I had collected during my fieldwork. Throughout my analysis I kept summaries across the data so that I was aware of what was being included or excluded. For example, I drew up a table for the interviews I conducted based on questions posed by Silverman

(2000) relating to the nature of the interview and how the interviews relate to the research questions. This was to enable me to have an overview and summary of the data collected.

**Fieldwork activity summary: Cohort 1**

Activity	Date	Time	Duration	Location	Comments
<a href="#">Meeting with and</a>	07/09/15	0900	1hr		Discussion about the student curriculum activities and my research. mentioned an IS cohort in November that I could observe
<a href="#">Meeting with and</a>	07/09/15	1000	3hrs		Discussion about IS project and other areas of study (PDSA). My research was also discussed.
<a href="#">Informal meeting with</a>	10/09/15	0900	1.5hrs	Stirling	explained the projects had already been involved with and what had learned from these. also expressed an interest in being a participant.
<a href="#">Scan of area</a>	16/09/15	0900	0.5hrs	Outside Clinical Skills	Recorded observations from the waiting area outside Clinical Skills.
<a href="#">Interview with</a>	16/09/15	1000	1.5hrs	Clinical Skills	Formal interview, recorded and transcribed. Focus was on experience of IS and what was hoping to achieve with this IS project. <a href="#">Reflections</a> .
<a href="#">Scan of area</a>	23/09/15	1000	1hr	Main entrance of	Recorded observations of entrance from the bus stop to the main concourse.
<a href="#">Observation with</a>	23/09/15	1100	1.5hrs	wards	Visiting the wards (not the acute ones) so could describe project and see what the procedures were on the wards, and which might be suitable for project.
<a href="#">Meeting with and consultant</a>	23/09/15	1400	0.5hrs	Consultant's office	We met with Dr for to explain IS project (and what had seen so far). I also explained my project. asked about patient confidentiality and asked me to amend my staff information form.
<a href="#">Observation with</a>	23/09/15	1430	2.5hrs	Ward	First visit to ID ward trialed forms for Point Prevalence pilot study by recording AMP and other drug prescribing (PDSA)
<a href="#">Scan of area</a>	28/09/15	1000	0.5hrs	Ward corridors	Continued to scan the wider area from the concourse to the ward corridors.
<a href="#">Meeting with and pharmacist</a>	28/09/15	1100	0.5hrs	Pharmacist's office	Met with pharmacist to discuss data collection and wards that were reporting back for HEAT targets.
<a href="#">Observation with</a>	28/09/15	1130	2.5hrs	Ward	Second observation of ward with amended forms (PDSA). also sent me the original and amended forms. <a href="#">Reflections</a>
<a href="#">Informal meeting with</a>	02/10/15	1100	0.5hrs	Clinical Skills	Met with to find out about project and to see what it would be possible for me to observe.
<a href="#">Observation with</a>	02/10/15	1300	2hrs	Ward	Third observation of ward with further amended forms to collect PP data (PDSA).

Figure 4.5: Fieldwork log with hyperlinks

It was also important to note that all the data I collected acted as prompts, helping me connect back to the situation. In the past I had conducted a Critical Discourse Analysis (Fairclough 2003) on policy texts and had also undertaken a narrative review (Greenhalgh et al. 2011). These approaches involved analysing secondary, textual data. The experience of analysing primary data is very different in that it is not just about the text but about reconstructing memories.

**Analytical strategy**

As emphasized throughout the chapter so far, the ontological orientation of this research required an approach to analysis that was thorough but not rigidly methodical. Adams and Thompson (2016) and Law (2006a) suggest asking questions of the data to ‘tell stories, stories about noise. Actor-network noise. The kinds of noises made by actor-network theory’ (Law 2006:33).

In my PhD plan, I had time ring-fenced under ‘analysis’, but this was referring to the time I had after finishing my fieldwork and before beginning to write up. I knew that these

stages were not discrete and there would be lots of overlap. Analysis is not a discrete part of the research process, but something that begins at an undetermined time (Crang 2003; Silverman 2000). For example, the reflective notes that I had been collecting during my fieldwork could be viewed as an example of ‘writing as research process’ (Denzin and Lincoln 2005) and as a way of shaping this process (Punch 2012). During and after collecting notes and observations from the field, I returned to the research questions to ask questions of the data. I used my research questions to ask what my data told me about my research area, also what was omitted and what my data could not tell me. For example, my observations were limited to the time I was permitted to be on the wards and with the students, and I was aware that it would not be possible to see everything.

I had a gap between organising the fieldwork and becoming reacquainted with it, as I went away to Canada for three months. I was awarded funds for an Overseas Institutional Visit from the ESRC, which stipulated that the work carried out during this time was separate from the main part of the PhD. When I returned, I went through the fieldwork notebooks, transcripts and reflections to ‘jog my memory’. I read the notebooks in hardcopy, and reimagined the incidents I had recorded. I had been using post-it notes to mark days and activities, with colour coding to indicate meetings and observations. I annotated the transcripts and reflective notes.

### **Follow the actor: how I navigated the research data**

I decided to ‘follow the actor’ (Latour 2005) as a way of attuning to materials during the observation, and later as a way to start analysing the data. The process of following the actor is to follow an entity which attracts attention in order to attune to the relations that occur in practice around the actor (Adams and Thompson 2016). In my research, I was conscious of not favouring the ‘big’ actors; this had been criticised as an approach in early-ANT work as it only told of the dominant features and networks, whilst silencing the less prominent (ANT and after). Although I had been conscious of this method before starting my fieldwork, I found it difficult to attune to specific actors and to follow these during observations:

Evernote reflection 5<sup>th</sup> October 2015

I have got reams of notes from this morning – it's really difficult to know what to pay attention to. I had decided to follow the actor – and had thought about a file or notes. But that was virtually impossible during the ward round. So what now? Follow the trolley? It's not as easy as it sounds. Some of the trollies go in rooms, some don't (I think). Maybe that's a starting point. Unlike other wards, everything is mobile in this one because the patients are all in different rooms ... Perhaps I could look at another ward to see the difference?

The note expresses how I tried to physically follow inanimate objects around the ward, but found that these are static for long periods of time. A later idea helped me to focus on the gentamycin form:

Evernote reflections 28<sup>th</sup> October 2015:

Maybe I could follow an antibiotic prescription from beginning to end? E.g. gentamycin? Then I would have a better perspective on the process.

Following the gentamycin form for me was about following numerous forms over time. As I continued with the observations I noticed the gentamycin form, but it was not until I started to analyse the fieldnotes retrospectively that I felt I was following the gentamycin form through time as well as space. My method for analysis was to look through my fieldnotes and use post-it notes to indicate where I had recorded information relating to gentamycin forms. I transferred these onto the PDFs of the notebooks as comments, so that I could search the notebooks. I also went through the transcripts to find references to the gentamycin form. I related this information to diagrams and photographs. This early experiment helped me to conceptualise networks in the data. It must be noted at this point that the 'actor' in 'follow the actor' is isolated as a discrete entity, which seems incongruent with ANT. However, my approach was to navigate my data and to become sensitised to connections and associations, and the actor was a way of starting this process.

I continued with the ‘follow the actor’ approach for Cohort 2. Here, I used the sticker as the actor. I started to incorporate the photographs more, and to use the photographs to help me to navigate around the data. For example, the sticker would start out as a page of printed colour stickers which needed to be cut into individual stickers by a guillotine. Following these practices helped me to attune to associations and forces as the stickers were being made. I found that I started to use different types of diagrams and collages to help to find connections and associations. The concept of networks was helpful and helped me to draw out insights from my fieldwork. There were some parts of my analysis using networks where I concentrated more on the power and effects through associations. Using an actor as a starting point helped me to sensitise to relations rather than focusing on individual entities. In Chapter 6, I describe three networks: two of these were started by following the actor (the gentamycin form, the sticker) and the last focused on relations and effects (IHI Practicum). I did not consider these approaches to be mutually exclusive: rather, I either identified an actor first to map the network, or I had effects as a starting point.

I made decisions relating to the anecdotes: some ‘won’, whereas others were excluded. These choices were political, in that they changed the way the chapter reads, and what is included and what is not. This chapter was therefore performed into being and shaped by practice: David was never hiding in the marble, his shape came from an assemblage of stone, implements and artists. In the same way, my research is not an innate ‘thing’ that I am representing, faithfully, through my writing. My writing is a thing in and of itself, shaping the reality that my research has become. It is neither right nor wrong, it just is, because there is no truth to measure it against. The focus of interest for this study is how the students were part of relational learning, and creating realities of SLISPs. The key points drew out insights from the three anecdotes in the analysis and how these were described through the lens of the ANT dimensions of networks, symmetry and multiple worlds.

### *Symmetry and multiple worlds*

As I moved on with my analysis I realised that other ANT concepts could help to describe alternative insights from the data. I drew on the concepts of symmetry and multiple worlds as described in Chapter 3. I produced collages for cohorts one and two using photographs I had taken and annotated. I also constructed what might be termed

‘narrative pathways’; these were similar to concept maps used in qualitative inquiry (Butler-Kisber and Poldma 2011). Images and pictures can be problematic as these tend to assume a representation of the data and can sometimes reinforce boundaries around objects; my intention was for the visual diagrams to be creative rather than reductive (De Freitas 2012). However, Decuyper and Simons (2016) describe figures as ‘*descriptive objects in their own right*’ (378, original emphasis) and as a way to highlight relations. The diagrams and images drew attention to the relations between entities and the assemblages of heterogeneous materials that gathered in different practices. In this research, I turned to images as way of analysing the data rather than trying to represent patterns. In addition to the assembling images, I developed a technique to challenge the boundaries around objects. By using the ‘remove background’ function on PowerPoint as mentioned earlier, and trying out different ways of cropping the photographs, I found I could isolate certain parts of the picture through the programme (an algorithm, I presume, that was based on light and contrast). The resulting images were of parts of bodies, bits of paper, scraps of waste, parts of tables, laptops *et cetera* that were hybrids. For example, one image was of some hands and a sheet of paper. This helped me to attune to hybrids and provided a way for me to represent connections and associations without separating out specific ‘parts’. In other words, I could maintain the complexity and inter-relatedness without arbitrarily reducing by coding and categorisation as would have been the case in other approaches. For me, this was a contrast to theoretical approaches found in health which consider materiality as separate from the human and compartmentalised; approaches that list and lump together objects and people without considering how they are connected in practice. Because ANT draws out relationality, having a visualisation of hybrids such as *paper-table-laptop* or *hands-form-sticker* made it easier to avoid these reductions (Fenwick and Edwards 2012).

### **Exploring SLISPs**

This chapter has set out the ontological position of an empirical ANT approach, and how this shaped the research design from fieldwork to analysis. The ways in which I used the three ANT concepts of networks, symmetry, and multiple worlds to guide the analysis are explained in the next chapter. Looking at networks enabled me to identify specific areas and stories that I could trace through my data. The difficulty with networks was where to ‘cut’ the network, i.e., where to decide to stop. Symmetry offered yet another area of focus, drawing to attention some of the specific elements within a network, and

the interactions and effects. Looking at the fieldwork as multiple worlds provided new insights that were not necessarily distinct from networks, but offered a different facet.





## Chapter 5: Analytical Strategy

## **Introduction to the analysis**

The following three chapters each focus on different dimensions from ANT: Chapter 6 focuses on networks; Chapter 7, symmetry; and Chapter 8, multiple worlds. Three anecdotes were constructed from the data (Adams and Thompson 2016): antimicrobial prescribing from Cohort 1; insulin recording from Cohort 2; and pedagogies of improvement science for both cohorts. The three anecdotes are analysed in each chapter, drawing from each of the three dimensions. The analysis process thus unfolds by drawing from this divergent form of analysis, which might be referred to as '*untriangulation*'.

### **5.1 The three ANT dimensions**

The analysis process was structured by first identifying three ANT dimensions: networks, symmetry and multiple worlds. The rationale for selecting these dimensions was described in Chapters 3 and 4. Three 'anecdotes' were then constructed from the field data and each of the three anecdotes was analysed by drawing from each of the dimensions. This section outlines the analytical process for each of the ANT dimensions. The three anecdotes are described in the next section. I applied questions from each of the three ANT dimensions: networks, symmetry, and multiple worlds, to guide the analysis, which followed on from my two main research questions, outlined on pages 10 and 11.

#### **Networks**

The first dimension of networks provided a way to conceptualise the data. I started with a set of questions that were developed through engagement with the literature on networks and education (Fenwick and Edwards 2010; Nespor 2014) and through supervisory meetings relating to my research questions: How do elements assemble? What gets left out? What is the nature of the connections (strong, weak, or temporary)? What is produced as an effect of these connections? What work is holding the network in place? The method of 'follow the actor' was drawn from to explore networks and is often taken as a first step for attuning to relations and associations in empirical studies (Latour 2005). 'Follow the actor' is a method whereby a particular object comes to the attention of the research and is then followed. My attempts to physically follow actors during observations was thwarted, as the movement of the objects in the study was erratic; I discovered that objects would remain stationary for long periods of time before being

carried, pushed or transported very quickly during an outburst of activity. I physically followed the students, but I wanted to ensure that I attended to actors participating in the network which were not always obvious from the start. For example, one of the objects in the network for Cohort 2 was a guillotine that was used for cutting paper. I attended to this object, but found the connections too limiting to draw into an anecdote. It was by reading the data repeatedly and writing out descriptions of the data that I pulled together and constructed anecdotes that were substantial enough to be analysed through each of the ANT dimensions.

### **Symmetry**

The dimension of symmetry provided a spatial metaphor that drew out alternative insights in the data. The questions put forward to explore symmetry were structured to reflect questions of symmetry in the literature (Fenwick and Edwards 2010; McLean and Hassard 2004) and critical questions asked of the literature in this field (Goldszmidt and Faden 2016): How does the format of documentation influence learning and knowledge for the students? How does the configuration and positioning of materials affect student learning? How do materials influence behaviours? How are educational aims realised or resisted through different assemblages? How do materials invite/exclude or regulate participation in practices? Who or what is excluded? Writing in a symmetrical way was challenging: the accounts required equal treatment of humans and non-humans. Other studies have explored how this might be done in medical processes (Bruni 2005), and I also drew inspiration from literary fiction (Parker 2016). Adams and Thompson (2016) have also developed approaches for writing about the non-human. The visual images I created through collage and montage focused attention on the situatedness of practice and the relations between parts of objects.

### **Multiple worlds**

The dimension of multiple worlds enabled the theoretical developments from after-ANT to be included in the analysis. The set of questions to explore multiple worlds were inspired by after-ANT literature (Fenwick 2009; Fenwick 2014a; Fenwick 2014b; Law 2004b; Mol 1998; Mol 2002): How are different enactments related? How do they hang together; i.e., how do different enactments coexist in the same practices? Which reality 'wins'; i.e., which enactment is more dominant? What is at stake; i.e., what is sacrificed by making the decision to choose one version over another? I addressed these questions

by troubling ambivalences and ambiguities in the data and exploring these using a praxiographic approach (Mol 2002). Whereas conventional qualitative approaches seek to close down ambivalences and ambiguities and to treat these as outliers or confounders (for example, Carney et al. 2010), praxiography follows a divergent trajectory, where difference is unfolded and explored (Law 2004b). Often this exploration leads to increasing complexity, and things which seemed to be a singularity become multiplicitous. In my analysis I noticed small, mundane details that could easily have been overlooked, such as dropping a clipboard on the floor, that signposted to different worlds of practice on the ward. The notions of regulating difference and collateral realities, described in Chapter 3, were then applied to investigate how worlds of practice existed alongside each other, in some cases requiring a singular narrative and in some cases submitting or dominating over another world. The act of shaping reality through practice was explored through ontological politics.

## **5.2 Constructing the anecdotes**

Three anecdotes were constructed following the process described in this chapter. The first anecdote comes from Cohort 1 and relates to their SLISP on antimicrobial prescribing. The second anecdote is from Cohort 2's SLISP on insulin recording. The third anecdote relates to both cohorts and draws attention to the pedagogies of improvement science. All three anecdotes were analysed using the three ANT dimensions described in the previous section: networks, symmetry, and multiple worlds.

Adams and Thompson (2016) developed a methodology for 'constructing anecdotes' or stories through the data which describe how relations and associations are formed. The anecdotes that were constructed in the following chapters came about through a process of attuning and noticing (Fenwick 2014b) entities and processes that were mentioned frequently in the fieldnotes and interviews, and then writing descriptive accounts of these. Adams and Thompson (2016) state that it is important to be explicit about the method of constructing the anecdotes, and to describe how particular entities and processes came to attention. In this thesis, the method for noticing entities and processes was to construct the anecdotes through the process of writing descriptive accounts. Some of these accounts proved more illuminating than others, making more connections with the data and extending throughout the activities of the cohorts. These were selected for further

analysis. The written accounts that did not form as many connections were discarded. The process was made rigorous by following a number of entities and processes, constructing anecdotes, and selecting those with the strongest and more numerous connections. This provided robustness and rigour to the process, without being systematic and without attempting to impose patterns in the data to produce ‘fundamental rules’ (Law, 2006:33) which gloss over ambiguities. It would be incongruent with ANT to follow or offer a rigid set of steps to ‘apply’ to the data:

Research methods are often designed to smooth away and simplify the messy lumpishness and most interesting complications of the world, in well-intentioned efforts to *know* them and make things clear. (Fenwick and Edwards 2010:144, original emphasis)

In this analysis, writing and visual methods were employed to draw out descriptions that highlight educative practices in SLISPs. The writing was part of the analysis, and was informed by repeated readings of the fieldnotes and interviews. These notes were annotated for connections as entities and processes were noticed (Appendix 4). Visual methods such as collage (Crang 2003), annotated diagrams (Decuyper and Simons 2016), photomontage (Latour and Woolgar 2013) and photograph editing were drawn from to interrupt the analysis process and to notice and unfold ambiguities in the data.

### **Anecdote 1: antimicrobial prescribing**

The first anecdote comes from Cohort 1, led by medical student Chris. Chris’s area of improvement was in antimicrobial prescribing.<sup>10</sup> This is a specific area of patient care where antibiotic medications are prescribed orally or intravenously to prevent or to treat bacterial infection. There are many antibiotics that are prescribed in hospitals, and the recording procedures require different forms to be completed with details such as the date, duration and dose. Accurate recording is imperative, as incorrect records may lead to ineffective treatment or harm from the exposure to antimicrobials. Chris was active in national groups, including specialist policy groups such as the Scottish Antimicrobial Prescribing Group (SAPG), and identified several key contacts from pharmacy and

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<sup>10</sup> Antibiotics are made from microorganisms to kill other microbes, but antimicrobials are a wider term relating to substances, synthetic or otherwise, that kill microbes or prevent their growth.

clinical roles involved in this area who I later interviewed. I observed Chris carrying out the first section of the SLISP, which involved carrying out a Point Prevalence Survey (PPS) to collect baseline data on antibiotic prescription practices on two wards (Wards 1 and 2). In Chapter 6, the networks relating to the ‘antibiotic story’ are described, with an emphasis on the gentamycin form to ‘follow the actor’. These networks include: existing networks of practice that Chris becomes attuned to on the wards; and the IHI and improvement science networks that create forces and effects that are not stable but enable new network connections between the SLISP and existing practices, resulting in effects of learning and change. In Chapter 6 the focus turns to the physical properties of the gentamycin form, other medical forms and their locations around the ward as well as in organising devices (trolleys, ringbinders, clipboards). These configurations are described in terms of how they affect the SLISP and the physical practices these bring about. Chapter 6 then hones in on the multiple worlds that emerge from troubling ambivalences in the recording of ‘duration’, one of the features of antibiotic prescribing. Multiple worlds are illuminated in the different practices engendered by the practice of recording duration, resulting in challenging authority and the tensions between following protocol and exercising professional judgement.

### **Anecdote 2: insulin recording**

Anecdote 2 comes from Cohort 2 which included Lee (medical student), Taylor and Alex (pharmacy students) as they carried out their SLISP. Cohort 2’s SLISP took place over a four-week period, in which the IHI Practicum templates (PDSA cycles, run charts and so on) were completed (Appendix 3). The aim of Cohort 2’s SLISP was to record more details about insulin-dependent patients within the first three days of admission, with the long-term goal of reducing incidents of hypoglycaemia. Insulin is a high-risk drug, and incorrect administering is an avoidable harm. Insulin is usually self-administered, and the patient is considered to be the best person to know about their own requirements. However, when patients come to hospital with an illness it may affect their eating, and their insulin levels might also be affected by the stress of surgery and other conditions. The clinical staff on the ward therefore need to administer insulin, rather than the patient themselves. Additional information relating to insulin is therefore required on the medical reconciliation form. The students from Cohort 2 were creating a sticker in the form of a strip that would be stuck on the end of the form. The purpose of the sticker was to temporarily change the form by adding boxes, and then running tests with it on

the ward to see if the additional information from the boxes would justify a permanent change to the form. The sticker was followed through the data as a way of guiding the analysis through the ‘follow the actor’ method.

In Chapter 6, networks of practices are explored in relation to learning, as the sticker is designed, printed, implemented and tested. In Chapter 7, the agency of the heterogeneous elements of the sticker network are explored in terms of other practices that the students become involved in as part of the SLISP, including the door buzzer access system to the pharmacy office, the bleep system for contacting clinical staff, and online social networking to communicate information. Chapter 8 follows the enactments of clinical spaces by different roles, and investigates how this affects behaviours and impacts on the development of professional identities through the process of insulin recording.

### **Anecdote 3: pedagogies of improvement science**

The usual format of a SLISP is a four-to-six-week improvement implementation that is reported through the IHI Practicum using templates for PDSA cycles (Appendix 3), balancing measures, run charts, process models, fishbone diagram and project charter. The SLISP for Cohort 1 was part of a wider quality improvement project, so the student, Chris, did not complete the IHI forms in the part of the project included in this study. Students either work on their own or in teams to complete a SLISP, and the IHI resources are sometimes brought in as a boundary to surround the project. Although SLISPs are student-led, approval is needed from the relevant clinical staff. In some cases, as in Cohort 2, a clinical lead had already scoped an improvement before introducing it to the students. This strategy ensures that improvement projects are relevant to working practices. In the case of Cohort 1, the student’s supervisory team provided advice and guidance. However, in terms of the practices of a SLISP, the students are expected to work unsupervised on the projects. Because the work for the SLISP takes place outside of a classroom, students are expected to find their spaces to complete the project, and learning spaces can include any number of physical areas, including meeting places, seminar rooms, corridors, and the locker room.

Chapter 6 looks at the processes that affected both Cohorts 1 and 2, including the forces and effects of the IHI practicum itself, and how these effected the enactment of practices in improvement science. In Chapter 7, the implications of using electronic forms from

the IHI are explored, including hardware, software, electricity and Wi-Fi. In Chapter 8, the enactment of SLISPs is reflected upon in terms of the multiplicity of versions that emerge and the differences in conceptualising concepts such as improvement science and students as change agents.

### **Learning objectives**

The learning objectives of the students differed slightly from each other. The medical student from Cohort 1 (Chris) was conducting a project drawing from improvement science with the purpose of completing a Master's degree in quality improvement. The medical student from Cohort 2 (Lee) was completing a Student Selected Component (SSC). The SSCs are available to medical students at stages in their study: if a student has failed a module and needs to retake it, then they will use the time to re-sit the module rather than doing an SSC. If a student has passed all the required modules, they elect to undertake an SSC in an area of their choice. The educational implications are that the SSCs are taken up by students who have successfully completed their modules first time around. The pharmacy students, however, were completing their project as their dissertation fieldwork. The educational implications for the pharmacy students were numerous: being off-site meant that they were away from their own university and not able to attend any events there; travelling to a different place made for a long commute that restricted the times they could be at the hospital; and, being in an unfamiliar environment, they were reliant on the medical student, Lee, for orientation.

The following chapters describe the analysis of all three anecdotes drawing from the three ANT dimensions. Chapter 6 introduces the first ANT dimension of networks, and explores the three anecdotes: antimicrobial prescribing, recording insulin, and pedagogies of improvement science. Chapter 7 develops the three anecdotes by drawing on the dimension of symmetry to attend to heterogeneous assemblages of human and non-human entities. Chapter 8 further explores the three anecdotes by drawing from multiple worlds, first by troubling ambivalences in the anecdotes and unfolding these to describe multiple worlds of practice.



## Chapter 6: Analysis of Networks

This is the first analysis chapter drawing from the three ANT dimensions of: networks, symmetry, and multiple worlds. In the following sections, I analyse the field data by drawing from the concept of networks. I adopted the following questions to guide the analysis and to draw out characteristics specific to networks (Fenwick and Edwards 2010; Nespor 2014): how do the elements assemble? What gets left out? What is the nature of the connections (strong, weak, or temporary)? What is produced as an effect of these connections? What work is holding the network in place?

*The quotes included in the analysis chapters are fully transcribed from field notes or interview transcripts. In some places, words are replaced for the sake of consistency (for example, 'prescription chart' might replace 'XPAR') and the pseudonyms are also inserted. These insertions are indicated by square brackets.*

## **6.1 Anecdote 1: antimicrobial prescribing**

### **The gentamycin form**

In Cohort 1, Chris's SLISP aimed to improve recording procedures for antibiotics by ensuring compliance with protocol. One antibiotic in particular, gentamycin, was found to be in wide use on the wards. Gentamycin is commonly prescribed to patients before surgery as a measure to reduce instances of Hospital Acquired Infections.<sup>11</sup> The prescribing practices associated with gentamycin are complex. Doses are tailored to individual patients and involve various tests and calculations. Inaccuracy of prescription can lead to Acute Kidney Infection; therefore, a separate form has been devised and implemented on the wards so that all appropriate measurements can be recorded clearly (Figure 6.1).

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<sup>11</sup> Hospital Acquired Infections, as identified by the Scottish Government HEAT targets, include: staphylococcus aureus bacterium (SAB), resistant forms of this microbe (such as MRSA), and clostridium difficile (c.diff).

**ADULT PARENTAL GENTAMICIN (HARTFORD): PRESCRIBING, ADMINISTRATION & MONITORING CHART**  
Use for gentamicin prescribed intravenously (gentamicin infusion prophylaxis/infusions or syringeable doses (usually for endocarditis) via using card)

**NHS**  
Trust

Patient name: .....  
 Date of birth: .....  
 CHI no: ..... *Adult patient label*

**PROMPT ADMINISTRATION**  
within 1 hour of recognition of sepsis reduces mortality

**SIGNS OF GENTAMICIN TOXICITY**  
↑ urine output/vigilance or ↑ creatinine    OT/VESTIBULAR: NEW tinnitus, dizziness, poor balance, hearing loss, oscillating vision  
 Toxicities may occur irrespective of gentamicin concentration. Discuss with senior medical staff any new signs/symptoms of toxicity.

Age: .....    Sex: M / F    Source of first dose: .....    Document dose calculation here:  
 Actual body weight: ..... kg    Online calculator (prescription)   
 Height: ..... Cm    Manual calculation (see overhead for details)   
 Creatinine: ..... Cm .....    Weight based, creatinine not known

Sign: .....    Date: .....

**ALWAYS CHECK IF PREVIOUS DOSES HAVE BEEN ADMINISTERED (e.g. if ASE, surgical prophylaxis or one only section) AND DOCUMENT ON CHART TO ENSURE COMPLETE TREATMENT RECORD**

TOXICITY Before prescribing each dose check renal function	Gentamicin Prescription Record				Administration Record			Monitoring Record			
	Date to be given	Time to be given 24 h clock	Gentamicin Dose (mg)	Prescriber's signature, PRINTED name and STATUS	"Infuse over 60 minutes" Date	Time started 24 h clock	Given by	Date of sample	Time of sample 24 h clock	Cent level (mg/l)	Action / Comments (please initial action to be taken)
Cr = normal											24 hourly <input type="checkbox"/> 36 hourly <input type="checkbox"/> 48 hourly <input type="checkbox"/> Stop <input type="checkbox"/> Dealt/other:
Cr = normal											24 hourly <input type="checkbox"/> 36 hourly <input type="checkbox"/> 48 hourly <input type="checkbox"/> Stop <input type="checkbox"/> Dealt/other:
Cr = normal											24 hourly <input type="checkbox"/> 36 hourly <input type="checkbox"/> 48 hourly <input type="checkbox"/> Stop <input type="checkbox"/> Dealt/other:
<b>"If antibiotic therapy is to continue beyond 3 days consider oral switch. Review microbiology results and sensitivities"          Consider switching to streptomycin if IV therapy is still indicated to reduce risks of prolonged treatment with gentamicin</b>											
Cr = normal											24 hourly <input type="checkbox"/> 36 hourly <input type="checkbox"/> 48 hourly <input type="checkbox"/> Stop <input type="checkbox"/> Dealt/other:

"Discuss with an infection specialist before continuing onto a second sheet"

**If the measured concentration is unexpectedly HIGH or LOW**

- Were cover and sample times recorded accurately?
- Was the correct dose administered?
- Was the sample taken from the line used to administer the drug?
- Has renal function declined or improved?
- Does the patient have oedema or ascites?

**If in doubt, take another sample before re-prescribing and/or contact pharmacy for advice.**

118129

Figure 6.1: Gentamycin form showing the information that is required to be inputted, and the details needed for different stages of prescription, administration and monitoring. The red bar is intended to protrude from the prescription chart where all other medications are recorded.

### Existing and overlapping networks

Chris recorded gentamycin prescribing along with the other antibiotics as part of a Point Prevalence Survey (PPS) to collect baseline data for the SLISP. A PPS records the number of patients with a particular condition at a particular time. There are a number of factors associated with gentamycin which influenced its prescribing, recording and administering. Firstly, the initial dose has to be carefully calculated according to the patient's weight and test results. This is calculated either using the graph on the back of the gentamycin chart or by using a software program on a PC (not all PCs on the ward had the program). The dose is recorded by the doctor on the chart and signed off to allow administering by the nurse at a specific time. After the first dose, the creatine<sup>12</sup> levels of the patient need to be measured in order to calculate the level and time of the next dose. To do this, a blood test needs to be done and sent to the lab. The doctor obtains the test results back within a particular timescale, to avoid missing the time for the next dose. The doctor has to telephone the lab for the blood test results before they can do the calculation (on the chart or PC) and sign the chart so the nurse can administer it.

<sup>12</sup> Creatine is an organic acid synthesised in the kidneys and liver.

However, the nurses have set times of day to administer medications, so this was something else that could affect the timing of administering gentamycin. The gentamycin prescribing process highlighted the complex networks of practice that existed on the wards. The aim of Chris's SLISP was to improve antibiotic prescribing, as there had been reports that the current process was not always consistent. Any change to the process would interrupt existing networks and build new ones. Chris was familiar with the process of antimicrobial prescribing, and was involved with antimicrobial stewardship which connected with networks outside the wards, such as the Scottish Antimicrobial Prescribing Group (SAPG). The aim of Chris' SLISP was to implement an 'improvement' to the process of antimicrobial prescribing through engaging with improvement science methodology. Some of the changes were intended to be temporary in order to test the 'improvement'; once tested, more permanent changes would be implemented. In network terms, the final improvement would become permanent, or stable, where the improvement is enacted and integrated into work practices. However, this requires the existing network to become destabilised, which is disruptive to the assemblage of people and materials that have come together to repeatedly perform the practice.

### **The gentamycin form as part of the 'antibiotic story'**

In this section, I follow the gentamycin form as an actant in the 'antibiotic story' network. At the start of the SLISP, Chris investigated existing procedures and collect baseline data, in the form of a PPS, from different sources of medical records. The medical records referred to in the SLISP included the Prescription Chart, the medical file, the patient history notes, the Standard Early Warning Score (SEWS) chart and the gentamycin form. Each source contained information about what medications (including antibiotics) had been prescribed, the dose, duration and a record of when medications had been administered. The medical file held information relating to the reasons for starting or stopping a particular medication, and the patient history notes recorded information from other wards. The PPS required information from all the aforementioned sources, and Chris came to refer to this as the 'antibiotic story' (Figures 6.2 and 6.3).

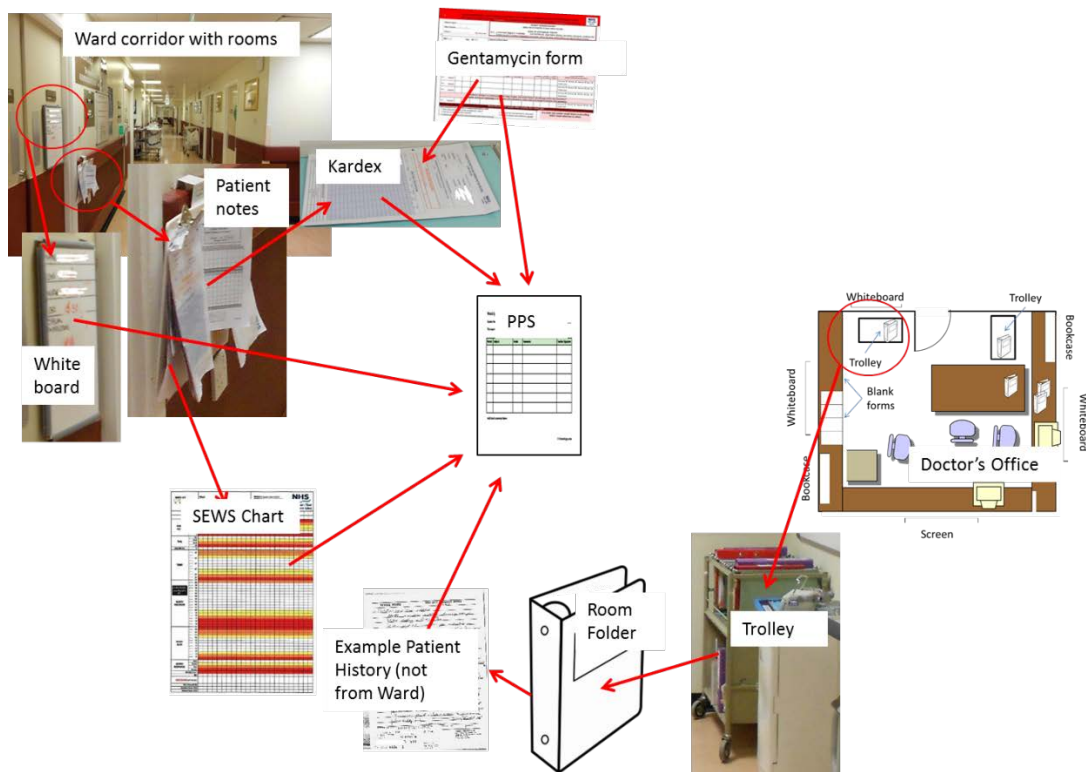


Figure 6.2: Narrative pathway – medical records on ward 1

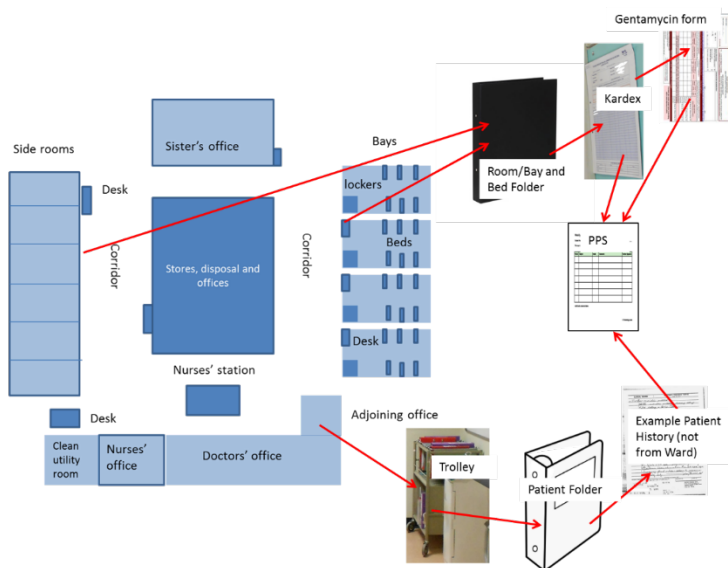


Figure 6.3: Narrative pathway – medical records on ward 2

The diagrams (Figures 6.2 and 6.3) describe what I term as a ‘narrative pathway’ of the medical information on the ward. It must be noted at this point, because of the non-representational nature of ANT, that these diagrams are not intended to represent networks, but are produced as ‘*descriptive objects in their own right*’ (Decuyper and

Simons, 2016:378, original emphasis). If the diagrams in this analysis were intended to represent reality, this would suggest an existing reality (ontology) with an epistemological explanation (what we can know about the reality). ANT eschews this bifurcation, therefore the diagrams in this analysis are a continuation of the empirically recorded reality rather than a representation of it. In other words, the diagrams form their own reality, not a representation of it. As Fenwick and Edwards (2010:165) describe, 'accounts of realities are performed at the same time as the realities they attempt to represent'.

Chris described the existing networks of practice on the ward and how this affected the SLISP:

Interview 2 with Chris, page 8:

... it would make it a lot easier if all of this stuff was in one place. But again, because they have quite a lot of documents, and they all mean different things about, maybe different conditions, or whatever. I think it's easier for them to have everything separate, but when you're focusing on one thing, that involves bits and pieces from different bits, you kind of wish there was one thing ... But again it depends for that ward where their priorities are ... So yes, it's difficult when there are so many different things in different places! And stories that go back. Because every time the doctors speak to the patient, I'm sure it's probably the same for nurses as well, they need to document it in the notes. So they will say, I spoke to the patient about X,Y, or Z, or spoke with the relatives. So you end up with lots of pages of this big story. And I'm sure when someone goes back to see the patient they don't read every single page. They probably just skim through it and miss a few things; which, they have to document for legal reasons and stuff like that as well. But it does start to get a bit messy and you don't know what's going to be where.

The interview starts to open up the diasporic nature of the information that would otherwise relate to a single patient and a single drug. The 'big story' referred to by Chris

is an amalgamation of accounts made by medical staff around the same patient. However, even though the information relates to one patient, there are several sources of paperwork. To add to the complexity, one patient will also have several strands of information following them from different wards, relating to different or ongoing conditions and associated treatments. The implication for the SLISP is that there are a number of different physical practices that need to be performed, and materials assembled, in order to reach an understanding of existing practices and what could legitimately be improved. Chris recognises that this information is dispersed and incomplete, and collected for a range of different purposes. From my observations, I could see that the dispersion of medical information was physical as well as textual, with related information written by different pens, on different forms and in different parts of the ward. To gather this information on to one form, Chris walked around the ward to physically obtain the different pieces of information. Figures 6.2 and 6.3 illustrate the different paths on different wards that Chris took to collect the data needed to piece together the ‘antibiotic story’. Although the paperwork for both wards was the same, the layout and procedures were slightly different and records were stored in different places. In some cases, Chris identified discrepancies in the records or different ways of recording, and so decided to verbally confirm with staff:

Fieldnotes from 23/09/15 page 16:

An ‘x’ against box instead of initial – so not sure if decided not to administer or if x is initial (will check with nurse). Student goes back up to station to check ‘x’ with nurse. Nurse explained that means ‘not yet started’. She explains it is not good practice.

This excerpt illustrates how learning has emerged as a network effect as Chris patches together the ‘antibiotic story’ through the gentamycin form, the prescription chart and the patient records onto the Point Prevalence Survey. It shows that the student was becoming familiar with the network of practices that are formed in relation to the medical records. In this case, the nurse is a point of translation in the network, connecting records and circulating knowledge through history and experience relating to the use of the inscription ‘x’. The nurse can be considered as part of the ‘antibiotic story’ network by translating

the meaning of symbols on the form. Chris also encountered points of translation between networks, as information is inscribed onto the Point Prevalence Survey form.

### **Anecdote 1 insights: learning as disruption**

Returning to some of the questions at the start of this chapter, this networks analysis of the ‘antibiotic story’ has highlighted the importance of understanding how existing networks overlap with ones that are just forming. The SLISP, originally considered as being something contained, bounded and newly introduced, is now re-presented through tracing the anecdote as a network in its own right, forming connections with other, existing networks. One of the insights from this part of the analysis is that medical forms, including the gentamycin form, are not objects that can be isolated from practice or from the patient, because the information they carry is contingent to practice. Berg and Goorman (1999) describe how information is extrapolated and moved around sometimes without considering the contingent nature of the measurements. The ‘antibiotic story’ illustrated the way in which information is distributed in different networks that are associated with different practices, and that the SLISP was a new practice that needed to connect with these networks. This anecdote also illustrates that even if an association is geographically distant, there may still be forces that affect the network and hold it together, such as the Scottish Antimicrobial Prescribing Group (SAPG) and the IHI Practicum. For example, SAPG connected Chris with clinical staff who were active in policy-making around antimicrobial prescribing, and with the policies themselves. The Scottish Government HEAT Target for Hospital Acquired Infections and subsequent hospital protocols were initiated by SAPG. The IHI Practicum website hosts completed improvement projects that have utilised their templates and practicum. This sets up the IHI Practicum as a stable network that has been mobilized to initiate new projects. During the SLISP, the IHI Practicum connects temporarily to disrupt existing practices and create new connections. The nurse’s translation of the symbol ‘x’, for example, shows that the nurse is connected to existing networks, even though they might not have personally been involved in that particular interaction.

The SLISP network brought with it improvement science methods, including PDSA cycles, balancing measures, and run charts to name but a few. For Chris’s SLISP, the ‘antibiotic story’ network is a new network that formed associations and connections as the SLISP was introduced to existing networks. The aim of the SLISP is to ensure the



new network becomes stable (for example, ensuring junior doctors perform the practices of the ‘antibiotic story’, and that the medical notes – gentamycin form, prescription chart and so on – contain appropriate symbols that connect with the rest of the antibiotic story). My study did not go beyond the initial stages of the project, so it is beyond the scope of this study to comment on whether the improvement was taken up and stabilised as a network. The anecdote demonstrates how the SLISP forms a temporary network for the duration of the project, and that the practices of improvement science are then deleted. The notion of deleting practices comes from (Law 2004b), and refers to the way that repeated performances of practice become more refined, resulting in a sleeker process which brackets some of the complexity. Learning is manifest in associations and connections between the new network and existing practices. However, it must be stated that networks are in flux and require constant work to maintain stability. Nesper describes networks as ‘fluid and contested definitions of identities and alliances that are simultaneously frameworks of power’ (Nesper 2014:9).

Having an entry point into the SLISP network through ‘following the actor’, in this case the gentamycin form, was helpful to start the analysis by helping to attune to the relations and associations between different actants on the ward. The narrative pathway diagrams also assisted with identifying relations and forces between actants and started the process of attuning to networks. In Chapter 7 the materiality of the medical documents is explored further to draw out ‘spaces or blanks’ (Fenwick 2011:98) that might otherwise be overlooked.

## **6.2 Anecdote 2: insulin recording**

### **The network of the sticker**

The rationale for Cohort 2's SLISP was to provide a means of collecting sufficient information on the ward admissions form and to reduce incidents of hypoglycaemia. The idea, put forward and trialled by the clinical lead prior to the start of the project, was to produce a sticker that could be stuck on the Medical Reconciliation part of the admissions form with adequate room and prompts to collect information on insulin (Figure 6.4). Stickers are often used on the wards to temporarily change a form before a permanent change is made. Existing practice for clinicians for admitting insulin-dependent patients is to fill out the Medical Reconciliation form and to include insulin alongside other medications. Patients who are identified as insulin-dependent require specific monitoring (Insulin Prescription and Diabetes Monitoring Record). However, all medications for the patient need to be summarised on the medical reconciliation form (medications are reviewed at every point of transition). The medical reconciliation form is a table with two sections: admissions medication and actions. Under the admission medications section is: name (generic), dose, frequency. Under the actions section: hold, stop, comments (if medication is held or stopped). Because insulin has to be given in specific doses at specific times, these headings are not enough to record relevant information.

This part of the analysis identifies the sticker as an actor (Figure 6.4). The sticker is followed through fieldnotes, reflections, interviews, documents and photographs throughout the duration of the project. The sticker had already been created by the clinical lead before the students arrived, then translated through brief interviews with clinical staff and mock practices such as the simulated patient. The colour of the sticker was changed during the SLISP, and the process of its production and implementation is described as it went through its many iterations. Different parts of the network, such as software, staff opinion, meetings and offices, are identified as effects in the account to form a story of the sticker network.

For ALL patients receiving Insulin please complete the following table								
Insulin Name & Device		Insulin dose				Last Insulin dose given Prior to admission		
Name	Device	Breakfast	Lunch	Dinner	Bedtime	Date	Time	Dose
		units	units	units	units			units
		units	units	units	units			units

Figure 6.4: The protocol sticker at the start of the SLISP

The medical student from Cohort 2, Lee, pointed out the temporary nature of the sticker during an interview, and highlighted the importance of collecting relevant information:

Interview with Lee: An account of the sticker (24/11/15)

It wouldn't be a sticker forever. The problem you have is that when you integrate stuff onto a form, it then blends into the background. And people don't necessarily fill it in. But it is ... it's balancing: is the insulin a high enough risk medicine that you need a completely accurate prescription, with is it worth getting it to blend into the back of the paper.

In this quote, the sticker could be conceptualised as producing network effects. The quote suggests differing strengths of connection in the network; for example, a permanent change to the form might weaken the network effect by 'blending into the background'. This suggests that the effect of the sticker is a stronger force in an unstable network, whereas a permanent change to the form might be a weaker force in a more stable network.

During the first student cohort meeting, the clinical lead outlined the aims and planning for their project. The students would be completing the project over the space of a month, so the clinical lead had already set up the project and gave the students a brief outline of how the project might continue from this. A PDSA cycle, an important part of the IHI Practicum, would need to be completed for each stage of the project, as part of the rapid tests of change (Appendix 3). The students were also required to complete other IHI Practicum documentation, such as a run chart, cause-and-effect model and a final report at the end of their study. In a similar way to Cohort 1, in this study the IHI Practicum

templates are conceptualised as a new network that would overlap and create connections with other networks. After the project, the network connections would either form a stable network, or, once the IHI Practicum is no longer part of the network, the new network might become unstable. The work to stabilise the new network involved the students consulting with staff members on what they thought of the sticker in order to produce a version that would be most relevant to their practice. Once an agreed version of the sticker was produced, the students needed to monitor the number of insulin-dependent patients and whether the sticker had been completed for these patients. Taylor explained the purpose of the sticker and some of the difficulties the group encountered:

Interview with Taylor: Encountering problems with the sticker  
(26/11/15)

So we started off with a sticker that had already been sort of tested by another group and then we took it on version 3. And then we created like a form using Google Drive, where we knew what feedback questions we wanted to ask clinicians when we asked them to use it. But to begin with, we were trying to catch diabetic patients and get the clinician to actually use it for a diabetic patient. But we found out that, on that ward, there wasn't a high rate of diabetic patients, so we had to sort of adjust our method of testing. So we decided to use scenarios [patient simulation], where we'd come up with insulin regimes, and then we would test that with the sticker instead. So we used the feedback form, got a clinician, and just sort of pretended to be a patient, got them to fill it out and then used the feedback form to sort of create a structure to what questions we were going to ask them. And what answers they gave us as well.

Ward 3, a receiving ward, is very busy most of the time, with a high patient footfall. Not all the staff were accommodating to the students' requests for help and participation in the Patient Simulation, although many were very helpful and took time to work with the students. At this stage, it could be seen that the SLISP was forming its own networks that were interrupting existing networks on the ward. The students were attempting to destabilize the existing practices of medical reconciliation and create a more detailed

recording system for insulin. The patient simulation enabled connections to begin forming during the project: the sticker destabilised the networks around the admissions form (for insulin dependent patients) by presenting an alternative way of recording. It was possible that the sticker would be overlooked because of stable existing practices resisting the change, but the sticker (and its prominent pink colour that connected to insulin recording) and the students (through patient simulation) were participating in the improvement being ‘performed into being’ (Fenwick 2011). Resistant forces not only included a lack of participation from the staff, but also authority and senior staff preventing participation:

Further sticker testing using scenarios (24/11/15):

They said the doctors were not buying in to it, that they told them to come back at 6 – this sounds like they are being fobbed off ... [Lee] and [Taylor] were saying that one of the [Foundation Year doctors] seemed keen to do the feedback, but another clinician (I think he is a registrar) stopped them from participating.

The extract from the fieldnotes illustrates that the lack of participation from some staff was creating destabilising forces in the SLISP network, in turn, stabilising the existing ones. The students persevered in their efforts to get the sticker integrated onto the form by continuing to speak to staff and ask for feedback. There was encouragement from other clinical staff regarding how to make the sticker more likely to stand out and to be noticed by staff, so these would get filled in, further supporting Lee’s idea of the sticker being more prominent. Resistance is explored further in the later example, Pedagogies of Improvement Science, where discourses of selling, such as ‘buy-in’ are seen as network effects that work against resistance. The next section describes how a stabilising effect on the network, the colour of the sticker, creates an association with the pink colour of forms relating to insulin (Figure 6.5).

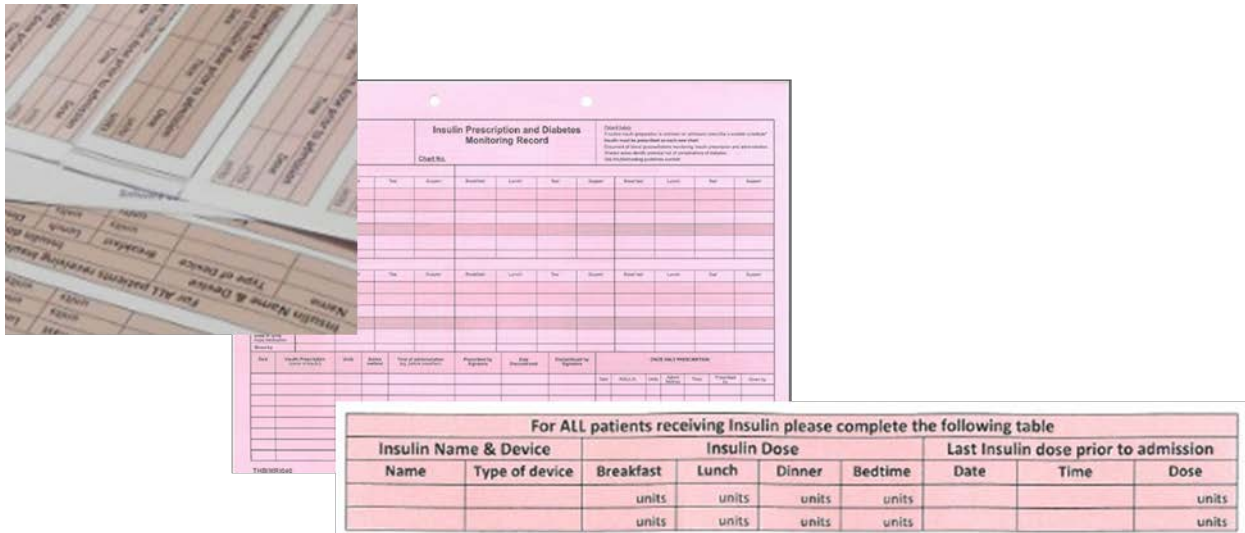


Figure 6.5: Insulin Prescribing Record (centre) with the new stickers; different shades of pink were experimented with to find a shade which could be associated with the insulin forms.

*Changing the colour of the sticker to ‘insulin pink’*

When the students asked the staff about the sticker, the nursing staff suggested to the students that they have the colour of the sticker as pink; this was because the insulin forms were all pink,<sup>13</sup> so there would be a mental association (Figure 6.5). Much later in the observations, Lee is seen to notice the colour pink in amongst other paperwork, and to immediately associate this with information pertaining to insulin:

Fieldnotes on noticing the pink (03/12/15):

Lee goes to look for a file for side room 2 as [they see] the pink form on the clip-board ... Gets clip-board from the outside of the door ... Goes to sliding scale on pink form ... Goes back to file and pink prescribing form ... gets the big patient file and flicks through to one of the pink forms ...

The students were hoping that the colour change would indicate the association to insulin and invite staff to complete the details. Changes to the sticker were documented by the

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<sup>13</sup> As well as the Insulin Prescribing Record, the Sliding Scale Form was also pink. The latter form records the administration of intravenous glucose, potassium and insulin to ensure appropriate dosage for the patient. When insulin-dependent patients undergo illness and/or surgery, insulin levels are difficult to regulate through food; intravenous administration is more rapid and reliable.

students on electronic feedback forms that they created themselves, and then recorded on PDSA cycles. When the students agreed on changes to the sticker, the next task was to go to the pharmacy office to meet with the clinical lead and to print some stickers off. The task required a colour printer and a guillotine, which were situated in the pharmacy office. The pharmacy office is located on a lower level, down a very long corridor. There is a buzzer system on the office doors with two buzzers. During the observations we would sometimes have to wait ten minutes or more for the clinical lead to come to the door. The buzzer became an Obligatory Point of Passage (OPP) for the SLISP network, i.e., a central assemblage 'through which all relations in the network must flow at some time' (Fenwick and Edwards 2010:18).

### *Stickers in cyberspace*

Iterations of the sticker were sent around the students in electronic format. As well as email and Google Drive, the group used Slack (a closed social media forum) to circulate documents. The sticker created effects of convergence and interruption, as different network forces pulled actants together or pushed them apart. At the start of the project, the sticker was an idea for changing a form. The idea was diffuse, coming from a combination of improving Medical Reconciliation procedures and reducing harm from the wrong insulin dose. Then the sticker became physical through a network of materials over different spaces in the hospital (the guillotine in the pharmacy offices, the locker room as a space to assemble the sticker onto the prescription charts, negotiations with clinical staff), a blue strip, becoming a pink strip, with boxes to record information. The students developed the sticker electronically. More heterogeneous elements were then enrolled into to the network: the Slack group, emails, Google Drive, laptops, iPads, shared physical spaces (library, meeting rooms). Network effects, such as staff suggestions to improve the sticker, came about through the students visiting the ward and approaching staff with questions and samples. This effect was to change the colour of the sticker to align it with the pink insulin forms that were in use on the ward. The shade of pink was negotiated between students and the shades of pink to choose from on the computer screen; wording on the sticker was also negotiated.

### **Anecdote 2 insights: effects of the sticker**

The sticker created small effects on the network whilst the students worked with clinical staff to form connections with the existing networks of practice, such as the association

of pink with insulin recording forms. Connections were formed with willing staff, but resistance came from the Ward 3 junior doctors. The result was a network in flux, precariously held in place with a temporary sticker, the effects of which were bolstered by staff feedback and the patient simulation exercise. The students recorded changes to the sticker on PDSA cycles, and mapped existing practices on process diagrams. As the SLISP progressed, associations formed between the students and the IHI Practicum templates, becoming stronger as electronic formats of the templates, such as the fishbone diagram, were repeatedly returned to, and created links with electronic software (Google Drive, Slack, IHI Practicum) and hardware (PCs, Wi-Fi, electricity). Manual forms were excluded from the process, further reinforcing links with electronic practices. The IHI Practicum created forces that governed how the tests of change were carried out (for example, through the PDSA cycles and the fishbone diagram) and how the SLISP was enacted. However, another network of practices formed around the physical production of the sticker, including the effects of the pharmacy office and its buzzer system as an OPP. The connections created effects of learning for the students as new connections were made; in the 'formation of linkages with learning as an effect' (Zukas and Kilminster 2012:44). And in terms of network effects:

knowledge is generated through the process and effects of these assemblages coming together ... learning itself becomes enacted as a network effect. (Fenwick and Edwards 2010:4)

In other words, knowledge can only maintain its status within the network, can only exist in association with other entities and is held in place through associations (Nespor 2014). The IHI has meaning for the students; the IHI network overlaps with the SLISP, which in turn overlaps with existing practices. The examples given described how these networks assembled, overlapped, and the enactments that held them together. In terms of what learning is being created for the students, being enrolled into the IHI Practicum network by undertaking the SLISP creates connections through the assemblage of materials such as the electronic templates; being on the ward creates connections with existing practices, such as the pink colour of the insulin forms and carrying out patient simulations with staff; and connecting these two networks to create an improvement that interrupts current working practices and requires ongoing work to maintain.



### **6.3 Anecdote 3: pedagogies of improvement science**

SLISPs are enacted differently in different situations, but the two commonalities are: improvement science methodology is used; and projects are led by students. Improvement science became an effect of both SLISP networks, but different in nature between the cohorts. The improvement science methodology and the different ways in which the two cohorts connect with it is explored in the first section of this anecdote. In the second section, student project leadership is explored, including how the projects were ‘sold’ to staff to form connections with existing networks.

#### **IHI network**

This chapter has started to explore the overlapping networks of the IHI Practicum and the effects this has on the SLISP. The practicum enacts knowledge in a particular way through a set of online teaching modules and templates for different stages in an improvement project. The IHI itself is an international body of experts who specialise in improvement in healthcare. IHI activities, chapters, contributors, are gathered on their website. A SLISP is organised around a set of paperwork and culminates in a project, which is submitted to the IHI website. During both projects, there were notable instances of powerful network effects that influenced the way the SLISPs were carried out. This section further explores how improvement science creates effects through the IHI and how the IHI, as an existing network, connects to networks of practices in the wards as the SLISPs are carried out.

#### *IHI Practicum forms*

As discussed earlier in this chapter, Chris had experience of the IHI practicum in previous projects, and was familiar with the paperwork. Chris’s project did not involve the visible completion of this paperwork; instead, this became a ‘mindset’. For example, Chris found that the IHI templates for the PDSA cycle were not necessary to carry out a PDSA:

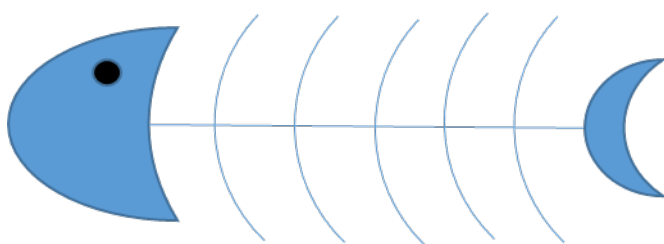
Chris, Interview 1, page 8:

Well, the PDSA cycles were really useful. And I find that you do it even though you’re not aware sometimes of you doing it. Because you kind of get into that mindset of: OK, I’m going to do this and I’ve got to plan this, and then you go try it and go: right, what should I change?

And then you change it; and then you're doing it without thinking about it. So, I will definitely take that forward, but kind of make it more explicit when I'm doing a PDSA cycle, because I think it helps look at your kind of progress from where you started and what you've changed.

Cohort 2's precise following of IHI practicum required the group to complete online forms and templates, which is explored in more detail in the next chapter on symmetry. Although an ANT reading with a focus on networks is useful for examining learning and knowledge through the IHI practicum, closer treatment with symmetry as the main focus would also be fruitful as the practices are entangled with technology and software. In this chapter, I focus on the network effects of IHI on both cohorts.

Cohort 2 were using the IHI practicum documents for the first time. Theirs was a four-week project, ending with the submission of the SLISP onto the IHI website using all the indicated paperwork. The forms and templates were electronic, so the group opted to complete these online. This impacted the materialities of developing the project, as there was a perceived need for the group to work in spaces where they had access to electronic equipment. At one point, one of the supervisors overseeing the project sent an example of a 'cause and effect' or 'fishbone' diagram to the students via the Slack site (Figure 6.6).



*Figure 6.6: Manual, simple fishbone diagram with no prompts.*

The diagram was a simple, manual drawing, and was dismissed outright by the group because it was not the IHI template. This exclusion strengthened the group's reliance on electronic means for the SLISP. The electronic template brought its own set of problems that created network effects:

Fieldnotes from 02/12/15 (page 52):

As they put together the fishbone diagram, the only line left is under 'measurement', so they discuss what else they should have in that category. Formatting the fishbone diagram seems to take a lot of time and negotiation; the model is not easy to manipulate. They check through notes for amends to fishbone from feedback from meeting this morning.

As this quote demonstrates, the model was the driver for how the students presented information. The line under 'measurement' was referring to a physical line on the template. Each line represents a different concept, centred on the 'problem', in this case, hypoglycaemia (Figure 6.7). The template comes with six 'bones' to indicate a particular issue (e.g., measurement) with smaller 'bones' indicating details of that issue. The students had found that they had a blank line and felt they needed to fill it in. Rather than having the issues as the driving force, the diagram was the driver: as Law (1994:12) points out, 'First, you need to draw a line between two classes of phenomena by distinguishing those that drive from those that are driven'. In this case, rather than deciding how many 'causes' and 'effects' needed to be recorded in relation to hypoglycaemia, the students took the number of bones on the template as the number of causes they needed to have, classing the diagram as a phenomenon that drove practice, rather than the students. The fishbone diagram could also be viewed as inviting practice (Fenwick 2014b); the blank 'bone' that the students felt compelled to fill in could be an example of blankness, which is used as a pedagogical device to prompt further thinking (Sørensen 2009).

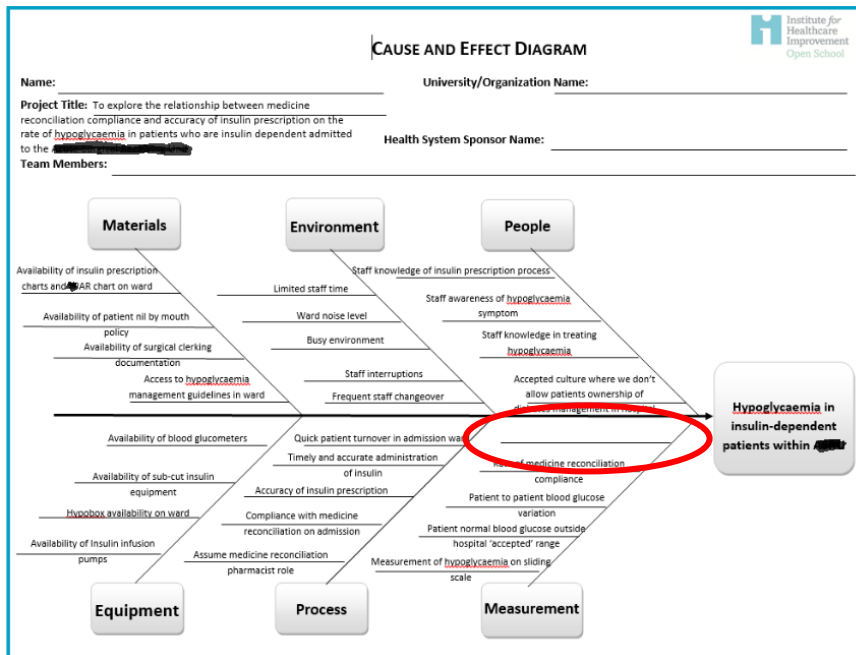


Figure 6.7: Electronic fishbone diagram

The IHI Practicum documents were accessed online, but there were opportunities for the students to work off-line. For example, the fishbone (cause and effect) template that the Hanton supervisor sent was a different version to the IHI and seemed to invite the students to draw their own template and decide themselves how many 'bones' they would have. This demonstrates the strength of the electronic form, as the manual form was overlooked despite being more flexible; when the students came to complete the diagram, they went straight to the electronic template, and no-one mentioned the manual diagram. The electronic templates created strong network effects in Cohort 2's SLISP, both strengthening the connections to the IHI Practicum procedures, but also weakening connections with other possible ways of doing the project. The reliance on electronic forms also strengthened the connections with hardware (iPads, PCs), software (Google Drive, Slack) and other entities (Wi-Fi, electricity, connections and points). The IHI Practicum, in Cohort 2, could be described as a 'network of prescription' (Fenwick and Edwards 2010:91) as this is what was promoted for the group members to adhere to. The manual diagram offered a 'network of negotiation', where other forms of diagram could have been included from outside the IHI, but this was not taken up.

*Discourses of selling and resistance*

Other network forces could be identified through discourses of selling and resistance. The clinical lead frequently spoke about ‘creating will’; also the other mentors (academic leads) emphasised the need for developing skills in resilience and persuasion.

My fieldnotes: being thick-skinned (25/11/15)

[Training Lead] said other [SLISPs] students have had run-ins with the staff ... understanding the culture ... surgery is the hardest ... depends on consultants, registrars, surgeons.

At the time, and in conjunction with other fieldwork experiences, the training lead mentioned in the above quote seemed to be making a case for the students to be more persuasive and resilient, and that having a ‘run in’ with staff was not unusual. This indicates the forces and effects holding existing networks together, and also the resistance to new networks.

For Chris in Cohort 1, their previous experience of SLIPs gave them an introduction to existing practices and how a SLISP can be introduced to a ward:

Chris, Interview 1 (16/09/15) page 1:

... normally as a student you kind of go in and stand in the background, stay out of the way as much as possible and you didn’t really want to annoy anyone or kind of give people more work that they should. So it was interesting to go in and actually work as part of team. And you found that a lot of people were quite enthusiastic about improvement. There was some people that had been involved in projects their selves, so it was really good just to kind of feel as part of that team.

This quote highlights what it is like for a medical student on a ward and the expectations staff have of students. In terms of the SLISP, Chris acknowledges the forces of staff on the ward: that they can ‘get annoyed’ or be enthusiastic, and that this is significant and can have an effect on the project. I had observed staff annoyance and enthusiasm on the

ward, but hearing the student say that this had the potential to influence the project reinforced the strength of selling or resistance as network effects.

Later on, Chris gave some specific examples of what had been learned and could be applied for the next SLISP:

... it's always worth going on and speaking to everyone when you first go onto a ward, just to find out, kind of what their role is. And even getting their opinion on what they feel should be changed. Because one of the things that I think I, not struggle with, but the kind of 'buy-in' to what you're doing. So you'll always find that some people are like, yeah, this is great. Like I really think this should go ahead and this is what we should be doing. Whereas other people were kind of like, "We've already got a few things we need to do, that's another thing that I need to think about"; or: "I'm so used to doing it this way, I don't want to change it." So it's kind of, you kind of need that communication. So, though, they feel that why you're doing it is important, so that they're willing, so teamwork's really important in that way, as well.

There were some notable situations with Cohort 2 where I was able to observe staff behaviours towards the students and their project. This influenced the mobilization of knowledge around the network. In this first example, Taylor and Alex experience hostility from ward staff whilst they are collecting data for their SLISP:

23/11/15 Fieldnotes from Taylor and Alex on Ward 4:

Coming back from ward, Taylor said [they] felt uncomfortable doing the data collection, more so than doing the feedback because people were not as accommodating on the ward as they were on the last one. It was very busy and people didn't seem to have time. The nurses were busy and didn't seem to have time to help when Taylor asked where the notes were kept ... It seems a lot harder for the [pharmacy] students as they don't know roles, timings etc., and the medical students do.

Also, the [medical] students are more likely to know and bump into people.

This excerpt also highlights the difficulties experienced by the pharmacy students in particular. In Cohort 2, there were many examples of the forces of behaviour and how these affected the projects at points of translation in the network. Their identities as medical and pharmacy students are not a given, but are enacted through network effects, and might be performed differently in other networks. What it means in practice to be a student in either of these disciplines is how the identity of the student is performed. For example, Lee spoke confidently about being on a ward, negotiating the paperwork and speaking with staff. In contrast, Taylor and Alex spoke about feelings of discomfort, feeling overwhelmed and ‘chucked in at the deep end’.

I was conscious of existing networks of practice as the students entered the wards; human and non-human actants were organised according to ward practices. The forms, folders, electronic information, tables *et cetera* were accessed by several types of staff. There were codes of conduct relating to walking around the ward and acceptable clothing. The networks of staff roles, power dynamics, experiences, responsibilities for life and death decisions, policies, protocols, forms, recording procedures, extrapolating patient knowledge, other risks to health, economic pressures, technological change, cumbersome old records, test results, levels and vital signs, these were the networks that the students were walking into. As a commentary to the previous sentence, it is with caution that lists are used in ANT: words and the names that are attributed to things may be the same length and contain similar letters, but what they describe are not similar. A good example of this is from (Borges 1974) and the *Celestial Emporium of Benevolent Knowledge*, which comprises an incongruent taxonomy of animals with awkward juxtapositions and categories, including ones that belong to the emperor, mermaids, and those that look like flies from a distance. The piece describes the absurdity of arbitrarily grouping things together, and draws attention to what is included or excluded when it comes to lists.

Walking into an unfamiliar, busy workplace was daunting for the students, especially when encountering resistance from staff. The clinical lead for the project created counter-forces by encouraging the students to ‘create will’ with the staff, and also offered to use their own authority to enforce the improvement. The training manager and supervisor

also reinforced this idea by talking about resilience. The students expressed surprise at being pushed to continue interactions and to be more insistent, but as the project progressed, the students acted more confidently. The staff also gave encouragement and praise:

Group interview 23/11/15 page 1 (Taylor):

I didn't ever anticipate that we'd have to be like, selling it ... I thought we would just be recording what had been already implemented or something like that. So I didn't expect to have to go and seek out people to try ... But I suppose that that's all, I suppose that this project's about. We've kind of just had a more front-line role than I thought we would have.

This quote highlights the implication from education of encouraging students to develop leadership skills, and relates back to traditional concepts of education as individualised and competency-based. However, an alternative reading could be: in order to mobilise knowledge, different parts of the network need to be performed and are stabilised around the IHI Practicum and SLISPs. To recall Mulcahy's (2014:56; original emphasis) 'tale' of learning as: '*associations, or connections, or relations* through which matter and meaning, object and subject, co-emerge', helps to describe how the effects of relations are important, and not just the attributes of the entities.

### **Anecdote 3 insights: stabilization of networks**

The Cohorts 1 and 2 were at different stages in their SLISPs. Chris from Cohort 1 had completed improvement science projects already, and was very familiar with the templates and the procedure. This experience formed a stable network of practices, and enabled Chris to take forward the improvement science methodologies as a 'mindset' rather than completing a set of templates; this implies that improvement science, in this case, had become mobilised. In other words, connections and translations took place on the projects Chris was involved in, which created learning effects. Cohort 2 were new to improvement science projects, and were relying on the templates as a way of negotiating learning through the project. The network for Cohort 2 was forming, and still unstable. For both cohorts, the SLISP was performed into being. Cohort 2 completed an electronic



Fishbone Diagram in favour of trying a manual one, further reinforcing the links with the electronic IHI templates, and forming network connections with electronic hardware and software and discourses of IHI. Discourses of selling and resilience became forces of persuasion and resistance in the SLISP networks for both cohorts. The roles of medical and pharmacy students illustrate the forces of behaviour at points of translation in the networks. Effects of fear and resilience emerged from the collision of existing and new networks, which is particularly strong for the pharmacy students who were new to the wards. The question: ‘what gets left out?’ draws attention to a notable exclusion: the patient. Although the patient is mentioned in accounts, the flesh and blood, embodied patient is not included. Although the students do not engage directly with patients during the project (with the exception of asking permission to look at notes if necessary), the patient is still present as a network effect through medical records. The patient’s body could be viewed as a manifest absence, where the presence of the paperwork creates and exemplifies the absence of the body (Law 2004b). The notion of the dispersed patient body is explored further in Chapter 7.

#### **6.4 Conclusions: networks and learning**

For both cohorts, there was the tension of interrupting existing networks of ward practices with an ‘improvement’. This ‘improvement’ formed a network in itself, starting with strong connections with the IHI Practicum, and forming partial connections with existing practices. As the projects progressed, the IHI network (which included the students as actants), disengaged. What stayed with the SLISP networks were connections and alliances that required continued performance and work in order to maintain an improvement. For Cohort 1, the improvement aim was a clearer sense of records relating to antibiotics which was achieved through building the antibiotic story. In Cohort 2, the sticker remained on the medical reconciliation forms on the wards, but once these ran out, the students would not be there to continue the improvement. The network effects of learning would necessarily change after the students completed the project, but the connections and alliances with the IHI Practicum meant that the students would be able to connect improvement science to other workplace practices in the future. This was the case with Cohort 1, where the templates were no longer performed into being in improvement projects, and were replaced with a ‘mindset’.

Conceptualising networks can help the researcher to empirically record associations and relations, and to seek and see them more easily. Without ANT, the researcher might focus their attention on specific people or things, especially those that are more highly featured than others. The following Chapters, 7 and 8, take from two additional ANT concepts: symmetry and multiple worlds. These concepts attune to different parts of the research to produce alternative readings, and to address the ‘spaces or blanks beyond networks’ (Fenwick 2011:98).

## Chapter 7: Attending to Symmetry

The purpose of this chapter is to continue the analysis of the three examples set out in Chapter 5 by drawing from the concept of symmetry. This approach will focus on the nature of the network as a heterogeneous assemblage of humans and non-humans, the forces these exert and how they come together. This chapter continues to develop the idea of knowledge as relations and forces that circulate through people and things, and the notion of learning as performances of and through these assemblages. Acknowledging symmetry helps us to question assumptions about learning and knowledge, and to apply approaches more critically by drawing attention away from purely on the human element and towards material relations and effects. This brings us closer to producing a language to articulate learning and knowledge as phenomena of time and space, which will influence the way we configure education.

Symmetry has been described as: ‘treating human and non-human elements as equally interesting, important and capable of exerting force upon each other as they come together’ (Fenwick and Edwards 2010:146). The argument for symmetry in ANT follows the notion that humans and objects are not seen as separate, bounded entities, but as assemblages with relations: ‘the abstract lines that pass between its components, rather than the contours that surround them’ (Miller 1997:355). Focusing on relations can be challenging for the researcher, as particular ways of seeing are constantly reinforced and favoured in ethnographic accounts. For example, Strathern (2005) describes how the binary between the self and the other is reinforced by self-description in anthropological accounts. The divisions between things, and between people and things, are articulated and perpetuated through these accounts. As Latour (2005) asserts, the separation of people and things, science and nature, gives us false binaries which do not adequately describe the messy, complex arrangements that make up everyday work practice. To provide a more ANT-inspired account, the examples in this chapter focus on assemblages and relations.

### **Using images and language to attune to materialities**

ANT approaches challenge conventional boundaries around things, attuning to how assemblages form in practice. This means moving away from compartmentalising objects and people, rather, as seeing assemblages as things that are ‘stuck together’ (Fenwick et al. 2011) through practice. For example, the electronic fishbone diagram can

only be accessed online, requiring an assemblage of elements such as Wi-Fi, electricity, PCs and so on. Using collages helped me to see assemblages of human and non-human elements and follow the fieldnotes to trace how these elements exerted force. This follows on from the network analysis, but has a focus on the balance of how humans and non-humans are treated. In the examples that follow, images are incorporated as a way of guiding the analysis, and as a way to interrupt and disrupt the way the data are articulated (Cragg, 2003).

Presenting a symmetrical account also challenges how effects are being created: for example, a straight ethnographic account might say: 'the student did this, the nurse said that, the doctor picked up the form'. The use of language in this example places humans at the centre and the source of all agency. In a symmetrical ANT account, the language needs to reflect the idea that agency creates effects, but this can come from both humans and non-humans. In this chapter, the examples illustrate symmetrical aspects that were observed during the fieldwork, following from the networks identified in Chapter 4. Visual images are experimented with in the analysis to draw out aspects related to symmetry in the data. I ask the following questions to highlight aspects of symmetry following Fenwick and Edwards (2010): How does the format of documentation influence learning and knowledge for the students? How does the configuration and positioning of materials affect student learning? How do materials influence behaviours? How do materials invite/exclude or regulate participation in practices? Who or what is excluded? How are educational aims realised or resisted through different assemblages (Goldszmidt and Faden 2016)?

## **7.1 Anecdote 1: antimicrobial prescribing**

### **Materialities of the wards**

Chris conducted a SLISP with the aim to improve prescribing practices for antibiotics, with a focus on the antibiotic gentamycin. In Chapter 6, I explored the gentamycin form as a network of practices, exploring which networks overlapped with those involved in gentamycin prescribing. The section described how different networks overlapped and how new networks formed; how the gentamycin form was connected to practices and the

patient; and how prescribing procedures and the threat of double dosing<sup>14</sup> held the networks in place. What is of interest in this next chapter is the way that humans and non-humans act during the project and the effects this produces. For example, how does the format of the gentamycin chart in Chris's SLISP influence learning? How does the configuration of materials affect learning? Who or what is excluded as the SLISP is carried out; i.e., what is noticed by using a symmetrical approach?

### *Physical properties of the gentamycin chart*

The gentamycin chart has a red bar across the top and a sticky strip on the back (Figure 6.1). The protocol is to stick the form into a prescription chart in the correct fashion so that the red bar protrudes, making it prominent. The prescription chart is a folded A4 booklet made of stiff paper, and is used to record all the medications for the patient. The information on the gentamycin form is also written into the prescription chart so that staff can see what medications the patient has been prescribed, how long the medications have been administered, and when the medication needs to be reviewed.

Charlie (one of the key contacts suggested by Chris) described, during our interview, how the gentamycin chart had been enacted in the past and the assemblage of materials it acted within. Charlie also gave a broader background to Chris's project and the groups involved in bringing about changes to the chart.

Interview with Charlie (12/11/15) page 5:

The problem was, in some of our surgical wards, when patients go to theatre, all of the paperwork, like their [prescription chart] and their clerking document, all has to go with them to theatre. But because the gentamycin chart sometimes got lost, it didn't make it to theatre with the patient. Because it was all in this big ring-binder, and it just all got mashed together. So the patient was getting gentamycin dosing in

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<sup>14</sup> Double dosing refers to the situation where a patient receives a dose of medication twice in error. This can be due to inaccurate recording or a lack of access to appropriate information. In the case of the gentamycin form, the administered dose would be recorded on the form itself, and was detached from the other notes. In theory this mistake would be avoided by recording information on the prescription chart in addition to the gentamycin form.

theatres, because they didn't realise they were on it on the ward, and they were getting double doses, and there were errors and things that were happening. So we came up with, working with the SPSP [Scottish Patient Safety Programme] team, to make the chart adhesive so that it stuck to the ... [prescription] chart, and therefore it would follow the patient wherever they went. So if they changed wards, or went theatre or whatever. So that was a local change that we made.

This quote draws attention to the importance of the physical properties of the gentamycin chart and how it configured practice, specifically the danger of the patient receiving a double dose.<sup>15</sup> Charlie also includes the forces of groups such as SPSP. The materiality is a particularly significant part of this practice, with the sticky strip as a measure to ensure the patient's records were kept together. However, I observed several instances of the gentamycin form on wards 1 and 2 where the sticky strip either was not used, or where an old version or colour photocopy was used, suggesting that the new format had not been connected stably into the network. Charlie's account also draws in how the patient is assembled with, and through, the paperwork.

For Chris's SLISP, the physical gentamycin form was related to the other forms kept with it, such as the prescription chart, the Sepsis Early Warning Score (SEWS) chart, and other forms:

Fieldnotes, 5<sup>th</sup> October, Book 1 pages 10 to 12:

In front of each room a double clipboard hangs on the wall at waist height. [Chris] checks the [prescription chart] from one of these, seated on a small wheeled table and chair ... Some clipboards are fiddly, papers could fall out ... Some notes on [prescription chart] are difficult to interpret ... Gentamycin chart: stuck onto drug chart with sellotape

Later observation, page 32:

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<sup>15</sup> Giving a patient too much gentamycin can lead to acute kidney failure.

Boards with lots of sheets, difficult to manoeuvre. One fell off when we tried to put it back on the dado rail.

The above quotes describe the assemblages of forms that are physically held together on clipboards (Figure 7.1), or stuck together with the sticky strip or sellotape. The physical manipulation of the clipboards to extract the gentamycin form is also combined with the complexity of reading the notes on the forms. This, along with Charlie's example, illustrate some of the effects (such as double dosing) of the configuration of the forms and the significance of ring-binders and clipboards to reinforce the connections between forms. From the above examples it is shown that paperwork is frequently manipulated, inscribed upon, inspected and moved.



*Figure 7.1: Clipboard with Kardex on dado rail; patient history file; trolley with ring-binders*

The photograph to the left in Figure 7.1 depicts one of the double clipboards with a prescription chart and other medical forms. In the centre is a photograph of a patient history file: these are usually very thick, and secured with an elastic band. On the right is a trolley with ringbinders. These trolleys can be moved around the ward; ringbinders can be taken out and put in other places. Because a range of staff use the prescription chart, Chris found it was sometimes missing from the patient notes. Being handled by so many people, and so frequently, translates to material wear and tear of the document. When the prescription chart is new and blank, it appears a sturdy document. It is made of thin card rather than paper, and is a gatefold design with eight sides for recording prescriptions. It is printed in colour (light blue, dark blue and red). In many cases the prescription chart will be put into a ring binder, so there are holes punched through the



form on the left-hand side. The filled-in forms can get scuffed, and sometimes the holes wear through. A filled-in chart can be bewildering, with numbers, letters and symbols in myriad boxes. In some cases, liquid stains are also evident. A single patient may have more than one prescription chart associated with them. Old prescription charts are supposed to be scored through. Handling the prescription chart can be problematic: the document opens out into a long document of four A4-size sheets. For the students, this means finding places to lean, finding places to rest folders on.

For the SLISP, Chris walked up and down the corridors in the wards to obtain the relevant ringbinders (Figures 6.2 and 6.3) and checked these against the patient notes on the double clipboards. Getting to the relevant sheet involved physical manoeuvring, and there was a risk of dropping paperwork. Other staff were also looking for the files and ringbinders:

Fieldnotes, 14<sup>th</sup> October 2015, Book 1 page 38:

On the table is a patient file. [Chris] leans on file on table to write; nurse comes out of the room and takes out a pen, pauses; I look at her quizzically, and she says “Oh, it’s OK, I’ll wait for you”.

The interaction described in the extract above illustrates how staff manipulate the same materials, spaces, tables and files. The nurse in this extract is part of a material assemblage, waiting with a pen to join the table, ringbinder and medical notes.

Throughout Chris’s data collection for the SLISP, ringbinders and patient history notes were being moved around on the ward on a trolley for other staff to use, or placed on the nurse’s station so that the staff member had a space to lean on whilst writing. The movement of the files and having multiple people trying to access the same piece of paper at once made for a complicated process for Chris to collect the information needed for the SLISP. Chris talked about the intricacies of collecting information from different physical places, and how this was confusing:

Chris, Interview 2, Page 7:

I can tell the percentages are inappropriate just by using the SEWS chart. But it also means now that I also need to look at the blood results to see the white cell count. Which, in some cases it's in the notes, the patient's notes, in other cases they'll have a folder with blood results. I've not quite worked out, in [Ward 1], everyone seems to be in the Blood Results folders. But in surgery so far there's been some in notes and some in the folder, and I haven't quite worked out when they're putting them in the folders and when they're putting them in the blood folders. I don't know if that's maybe just a mistake ... because they just popped it in the notes when they shouldn't have.

This is a significant realisation for Chris, identifying the different physical sources and then also querying whether the forms are in the right places. For Chris, piecing together the 'antibiotic story' from different sources required a lot of walking around the ward. As well as different forms, the forms were kept in different files and the files were moved around the ward. Patient history files were kept in the doctor's office (Figure 4.3); these are the large, manila, cardboard files that are thick and held together with an elastic band (Figure 7.1). Current patient notes relating to that particular ward were kept in ring binders, labelled with the room in which the patient was located; this is the folder that Chris refers to in the above quote. Ward staff, including doctors and nurses, frequently moved these folders around the ward, sometimes leaving them on the nurse's station or on tables outside rooms. The Blood Results folder, mentioned in the example above, is another folder which is kept at the nurse's station. The clipboards were kept on a dado rail outside each room, so these were usually not moved around the ward. The configuration of the folders and forms required Chris to physically move around the ward to collect information for the SLISP.

Another complication of manoeuvring materials was Chris's own equipment:

Fieldnotes, 2<sup>nd</sup> October 2015, Book 2 page 47:

Chris looked up drug on phone, [prescription chart] in hand ...  
Clipboard under arm, pen in mouth. Then puts phone back in pocket,  
puts [prescription chart] back, writes with pen ...

It was interesting to notice how the physical manipulation of the clipboards was also problematic for experienced staff:

Fieldnotes, 14<sup>th</sup> October, 2015, Book 1 page 40:

Nurse puts clipboard back and it slips, clatters to the floor. [Chris] picks it up, the papers have come out. Nurse turns around and jokes “Every time!” and laughs. Puts board back but it won’t stay. Replaces it on floor.

This quote illuminates the intersection of the different worlds of the nurse and the student, through the signpost to different practices: the nurse is taking the forms off the clipboard to find out about the patient and to see whether there are medications to administer, whereas the student is looking across forms to piece together the ‘antibiotic story’ to inform the SLISP. These differences move our attention from the materials themselves and onto the spaces that open up to the different sets of practices. The professional identities of the student and the nurse form as effects, as connections are made to different networks of practice. This example is explored in more detail in Chapter 6.

### **Anecdote 1 insights: configuring the ‘antibiotic story’**

The format of the gentamycin chart impacted on the SLISP, as it required physical manipulation to read, and then further effort to interpret the figures written on the sheet. Chris could not collect everything in one place and had to become familiar with the layout of the ward, where the paperwork was kept, who was using it, and when. Piecing together the ‘antibiotic story’ required walking around the ward and finding the relevant folders and files. The behaviour of the student and other staff on the ward was affected by material assemblages; for example, the nurse waiting for Chris to finish with a file, or the nurse accidentally dropping forms from a double clipboard. The stationery that was used to contain medical forms on the ward invited different forms of practice: the double clipboards hung on the dado rails outside patient rooms. The physical shape of the clipboards were not conducive to being moved around or stacked together, which regulated practice by keeping the clipboards on the dado rails next to patient rooms. The ringbinders were more portable and more easily left in different places; however, the

trolleys allowed for ringbinders to be kept together rather than distributed haphazardly throughout the ward. The material configuration and position of materials required Chris to perform physical practices that would not have been taught in a classroom or a simulated ward, even though these are practices central to the work of a junior doctor. Another exclusion in the SLISP was, again, the patient: in Ward 1, the patients were situated in side rooms and had become dispersed onto paper rather than the flesh-and-blood body in the bed. The student was performing patient care without coming into contact with the patient's body. During this example, a shift can be detected in the metaphors from networks to assemblages. By focusing on the configuration of materials and the forces these produce, there is less emphasis on the relational and more on space. This is similar to Sørensen's (2009) findings that the network metaphor does not 'fit' all scenarios. The implications for learning in this section, therefore, begin to diverge from the relational, networked metaphor. Learning becomes connected to more spatial analogies, for example, how the materials are distributed on the ward. Distribution (Mol 2002) allows learning and knowledge to become associated with spatial metaphors. The distribution of learning and knowledge is not only through space but through assemblages of human and non-human entities. The concept of symmetry therefore provides a way to think of learning and knowledge as distributed through 'things': 'In education, textual objects proliferate in such things as curriculum documents, maps, educational journals, parent newsletters, student record systems, exams, text books, competency lists, newspaper editorials, training software and test instruments' (Fenwick and Edwards 2010:8). In this example, textual objects such as the gentamycin form and the prescription form distributed knowledge which was further carried through other objects such as ringbinders and clipboards, and connected through points of translation.

## **7.2 Anecdote 2: insulin recording**

### **The student as a change agent**

In this example, symmetry is a focus to highlight points in the data that might otherwise be overlooked. The well-known magic trick of sawing a woman in half is a good example of practices that are overlooked and made invisible. During the trick, a female assistant enters a box, lies down, and pokes her feet out at the end of the box so the audience can see she is lying down. The magician then produces a saw and proceeds to saw the woman in half. The boxes are separated, then put back together. The lovely assistant emerges

whole and unharmed. The trick is that the audience assumes that the assistant is doing no work and is lying passively in the box, being lovely. However, the assistant is actually contorting their body into the upper part of the box, whilst the feet at the end are actually false feet which have been pushed out. This illustrates how assumptions can render some practices invisible. When observing workplace practices, if it is assumed that only humans do work and objects are passive, then some acts will be overlooked. One solution would be attending to detail during observations; another would be noticing other sources, such as interviews, stories and accounts that shine a light on practices that are invisible. The examples in this chapter illustrate how the researcher could have ‘missed a trick’.

The idea of students as ‘change agents’ is promoted on the SISCC website. This signals a shift from conceptualising learning as transmission to passive learners, towards active participation and situated learning. Whereas the learning-as-transmission tale (Mulcahy 2014) is traditionally measured through the retention of knowledge, situated learning requires a different approach. Sociocultural approaches to learning are focused on the collective, rather than the individual; materials are considered, but the human is still privileged with agency, and is the subject of assessment. ANT considers the sociomaterial as symmetrical, focusing on the actions of both human and non-human with equal interest. Conceptualising networks allows the researcher to attune to connections and associations from which learning emerges as an effect. Symmetry enables the researcher to notice the forces and effects of relations by considering the workplace practice as ‘flat’: that is, not imposing a hierarchy such as valuing human activity above all else. Thus the taken-for-granted practices that are rendered invisible by privileging human action can be considered. In Chapter 4, the sticker was identified as an actor to follow in the networks. In this chapter, the sticker and other parts of the network, human and non-human, challenge the position of the student as a change agent, and instead agency is considered as dynamic, not fixed, and as flows and forces between elements rather than properties of these; as McLean and Hassard (2004) argue, ANT focuses on effects and outcomes rather than ‘things’.

The sticker was introduced as a temporary change to the medical reconciliation form. The purpose of this for the SLISP was to test whether the introduction of the temporary change via the sticker would lead to more accurate recording of insulin for patients who

are dependent on insulin, and ultimately lead to fewer incidences of hyperglycaemia. For the students of Cohort 2, the sticker became the focal point of their project. This example explores how, rather than thinking of change agents, it might be more fruitful to explore the forces that emerge from the connections between entities and the effects these have such as learning, identity, behaviours and so on. A criticism of ANT is that powerful actors tend to be scrutinised more closely, which detracts from mundane detail and everyday practices that are necessary to explore in order to account for that which is taken for granted or overlooked. In this example, the sticker might be one such powerful actor. However, the sticker, in this example, is considered as an entry point to the data to explore some of the practices around the sticker rather than the sticker itself.

At the start of the project, the clinical lead demonstrated the process of making stickers with the students. The networks of practices required to produce the final sticker was described in Chapter 6, and included the sticker paper itself, the colour printer, the guillotine, the pharmacy offices, the medical reconciliation forms, 'creating will' through talking to clinical staff, and the locker room, amongst others. Moving beyond this description, there is much to be said about how materials invite/exclude or regulate participation in practices. For example, a human-centred account of the sticker would be: 'the students took the sticker paper to the pharmacy office and printed the formatted sticker on a colour printer. The students then cut the stickers with a guillotine to produce separate stickers. The students then peeled off the paper backing to stick the stickers onto the appropriate place on the medical reconciliation form'. This highlights the difference between socio-cultural approaches and socio-material approaches: the students are placed at the centre and are the only ones acting in the situation. In a socio-material account, the language needs to reflect relations and forces rather than sources of agency.

I recorded the process of producing the stickers in my fieldnotes. Although the account is still human-centred, the detail in the story starts to introduce the effects of non-human elements:

Reflective notes, 3<sup>rd</sup> December 2015:

Yesterday the students were really stuck. They had gone to a meeting in the morning and then went off to work on their cause and effect

diagram in a teaching room. Then they discussed going out onto the ward. They realised they did not have enough stickered forms (or weren't sure if they did) for the nightshift. They therefore needed to obtain some stickers there and then in order to get them on the wards in time. [Lee] went to sort the stickers out (collect the sticker paper) and to bleep [clinical lead] to get them printed out. [Taylor, Alex] and me went onto the ward to see if any diabetic patients had been admitted and if so, if the sticker had been filled out (properly). [Lee] contacted us to say that she couldn't get hold of [clinical lead]. We were stuck. What was the alternative? We could print them off ourselves, but [clinical lead] had the most updated version and hadn't sent it. We also needed to source another colour printer, but that wouldn't be too much of a problem. The problem was getting hold of [clinical lead]. As we stood in the corridor discussing alternatives, we saw [clinical lead] round a corner with another staff member. We took chase, but held off; imagine catching him, puffing and panting, and then asking him if he could print off some stickers? He was obviously busy and in a hurry and on the way to a ward. Luckily we caught him later and got our stickers, but I think everyone was suddenly aware of [clinical lead] as an [Obligatory Passage Point].

There are humans and non-humans exerting force in this situation that create effects. The first to consider is the electronic format of the sticker, which could only be accessed on a PC and sent to a colour printer and then cut with the guillotine. This equipment was situated in the pharmacy office. A buzzer entry system prevented entry to the pharmacy offices without permission from the clinical lead. The hospital's 'bleep system' enables the clinical lead to be contacted away from the office. The 'bleep' system is a set of practices used in the wards for contacting clinical staff. Each staff member is assigned a 'bleep' number which activates a device which the staff member keeps on their person. To contact a staff member, their bleep number is dialled on a telephone. The alert triggers a device, by making a sound; this affects the actions of the staff member, by prompting them to respond. The caller is then contacted via telephone by staff member. The practice requires the caller to be near the phone for when the staff member calls back. For the students (and myself) this required asking a ward staff member if we could use the phone,

and then being near the phone for a reasonable amount of time for the staff member to call back. This set of practices is triggered by the physical location of the printer, rather than being a decision made by a human. The physical practice of communicating with the clinical lead first involved a comment on Slack, the group's online forum (below).

Slack online conversation, 2<sup>nd</sup> December (CL=Clinical Lead):

[Lee] [/3:51 PM/](#) Can't find [CL] I'm up in the library trying to print stickers on my own account

[/3:51/](#)

How many more do we need?

[/3:53/](#)

I don't have version 5 of the stickers

[Alex] [/3:55 PM/](#) We've 16 in the ward

[Lee] [/3:55 PM/](#) Right can you try bleeping [CL] again I've tried twice and can't find him ... Going to try and print off my account the stickers we trailed

[Alex] [/3:55 PM/](#) Heading to the lockers

[Lee] [/3:56 PM/](#) Okay ... What will we do re: stickers?

[Alex] [/3:59 PM/](#) See , can [Cal] print them for us?

[/4:01/](#)

I think, there is nothing we can do.

[/4:01/](#)



Will hope 16 stickers will last till tomorrow.

[Lee] [/4:03 PM/](#) Okay ... Looks like I'll need to be in very early tomorrow again to get stickers done ... Did you try [CL] again?

[/4:03/](#)

I'm in the departure lounge but I tried the lockers but you weren't there

...

[Lee] [/5:12 PM/](#) We found [CL] when I went to return the stickers so we've topped them up in the meantime with the 8 [CL] gave us ...

[Taylor] [/5:14 PM/](#) Okay thanks for that! Just tell us where we need to collect them tomorrow. Have a nice night

The clinical lead could be considered to be an Obligatory Point of Passage (OPP, Callon 1984), as discussed in the last chapter. The reason for this is because the practices of making a sticker cannot take place without the clinical lead. The Slack conversation above highlights other actants that so far have been overlooked: the 'bleep' system and Slack itself. As indicated in the above Slack conversation, although the bleep system was followed, none of the students could successfully locate the clinical lead.

Slack is software for an online forum, so the students needed an electronic device (their phone or iPad) and internet access to see this. The messages could only be sent and seen if there was internet access, so there were at least two points in the assemblage that could prevent the flow and direction of practice. The configuration of materials, from the slack message triggering the bleep system to the incompleteness of the process leading to further messages on Slack, guided practice for the students as they worked on the SLISP. This calls into question that the clinical lead performs as the OPP: could the OPP alternatively be the bleep system, Slack, or the pharmacy door? An OPP is described as 'central assemblages through which all relations in the network must flow at some time' (Fenwick and Edwards 2010:18). With this consideration, it is possible to bypass the office and

online forums, but the clinical lead is a location of power in the network with the capacity to prevent the SLISP from continuing.

The guillotine also became a critical part of the process: later in the fieldwork there were examples of badly-cut stickers which had become illegible. The effect of the badly-cut stickers was to obscure other parts of the form, to disable the sticker from practices and prevent the improvement intervention. The badly-cut sticker was not doing the work required to stabilise an improvement network.

The next part of the process, sticking the stickers on the forms, also involved some unusual practices. The spaces where we stuck on stickers included the ward reception, the waiting area outside of the ward, the corridor, and the locker room:

Fieldnotes, 7<sup>th</sup> December 2015, Book 4, page 66:

At reception were lots of nurses, it seemed very busy. [Lee] asked where the stash of forms were and the nurse said there were a load of unstickered forms in the tray. [Lee] took a load of these and we stood at reception, sticking these in the forms.

Fieldnotes, 7<sup>th</sup> December 2015, Book 4, page 88:

We all put stickers in forms. [Taylor] collected stickers from [clinical lead] on Friday and Lee had forms in her locker. We stick as many as we have forms for in the locker room.

The cited examples from the fieldnotes are written in such a way that the human is still at the centre and the materials are mediating human action: 'Lee asked ... the nurse said ... Lee took ... we stood ... We all put ... Taylor collected ... Lee had ... We stick ...'. Finding ways to articulate symmetry between humans and non-humans is not always straightforward and requires effort to articulate and describe the examples in a different way. At this point in my analysis, I found a way of working with some of the images I took to interrupt my way of thinking and open spaces for new ways of articulating the data (Crang, 2003).

I found a way of seeing the example differently, by importing the photographs on PowerPoint and using the 'remove background' function. Seeing the photographs in this way it became easier to consider hybrids and assemblages. For example, in one of the pictures where the background has been removed, the student's hands are connected to the paper and the sticker. Instead of a boundary around what we assume to be separate entities (the whole body of the student, the sticker, the medical reconciliation form), the image instead draws a boundary around the hands-form-sticker (Figure 7.2). The boundary is set on the programme by an algorithm relating to contrast in the photograph, and so no judgement is made as to whether what has been isolated is a 'whole' object in the traditional sense, or parts of others. This is of interest because it challenges how entities can be conceptualised during practice – as hybrids or assemblages. The hands-form-sticker-lap could be regarded as an assemblage because these elements have come together to perform a specific practice, whereas a hybrid would be elements stuck together performing a variety of practices (such as me wearing my glasses).

The configuration of materials in this situation required the students to access and participate in several material practices (Slack, the bleep system, the door buzzer system, the electronic format of the sticker). Latour, writing as Johnson (Johnson 1988), suggests thinking of a simple thing, and then all the effort that is required if that thing is removed. In this case, it would be helpful to imagine what the sticker SLISP would look like if the sticker (and a stash of these) was given to the students. All the aforementioned material practices would be deleted, and the effects of learning would be different. In other words, if the students had not had to produce their own stickers, the learning effects produced by the engagement with other practices would not have occurred in the same way. The implications of this would be that the students might have connected with alternative practices and materials relating to the SLISP, but these might not necessarily be considered more or less relevant to the project: the emphasis sticker enacted practices as a group and assembled materials and spaces, such as PCs, online forums, the bleep system, corridors and the locker room.



*Figure 7.2: 'Remove background' – hand-form-sticker-lap assemblage*

### **The Secret Drawer**

An example of practices that have been overlooked is the 'secret drawer'; this term was used informally by the students, but reported on in the IHI Practicum report as 'a different location'. This refers to something that happened outside the observations, but which had a powerful effect on the SLISP. In Figure 7.2, the sticker is being stuck onto the medical reconciliation part of the admissions form. As already described, the sticker added boxes to the medical reconciliation to record more detailed information about insulin. In order to get the sticker filled in, the form needed to be placed in a prominent position; there was a risk that forms without stickers would be used instead, and then the insulin form would not be completed. The students were advised by the nursing staff to place the stickered forms at reception. However, the students found out that the doctors on night shift kept a stash of forms that were unstickered, in a 'secret drawer' as the reception desk was closed at night:

Fieldnotes, 1<sup>st</sup> December 2015, Book 4 page 37:

... [Lee] fed back on the night shift ... the [ward] Reception desk is shut down on the nightshift, so the FYs have a stash of forms in the doctors' room. The team were not aware of this, so now they can change the procedure to accommodate this.

Slack online conversation, 2<sup>nd</sup> December 2015:

[Lee] [/10:19 AM/](#) feedback meeting: We're struggling with the sticker implementation, is this a bigger issue with regards to insulin prescribing.

[/10:20/](#)

secret doctor stashes of paperwork have been identified

[/10:21/](#)

having the form in the paperwork incorporated doesn't = paperwork being completed

The 'secret drawer' is an example of 'missing a trick'; although the students and staff were aware that there was a different shift operating at night, they were not familiar with the different practices. In this case it was an insight made by Lee from talking informally to a junior doctor who had been on the nightshift. Lee made the connections to the paperwork not being completed due to the different location of the forms. The familiarity at that stage with practices, and the configuration of materials, allowed the group to understand the significance of the secret drawer. What ANT and symmetry bring is the attention to detail leading to this: the inclusion of a sentence in the IHI Practicum report does not reflect the surrounding practices and the effect of the students in realising that this was significant. These are situations where learning effects occur from making practices visible that would otherwise go unnoticed and unrecorded.

### **Anecdote 2 insights: invisible practices**

The sticker influenced how and where students worked, and what equipment they were required to use. The positioning of the pharmacy offices, the door buzzer, and other learning spaces, created the effect of a lot of walking around corridors and sometimes getting lost. To return to how this relates to learning, the above examples illustrate the '*associations, or connections, or relations* through which matter and meaning, object and subject co-emerge' (Mulcahy 2014:56; original emphasis). Situating students as 'change agents' places the students as driving practices of the SLISP. The position of the pharmacy office and the restricted access was a driver of activity: 'First, you need to draw

a line between two classes of phenomena by distinguishing those that drive from those that are driven' (Law 1994:12). Attuning to detail and noticing the effects of local practices allows for other materials to be considered as having effects. The accounts of the sticker highlight the particularity of the examples and how ANT is non-representational. The detail, complexity and mess of practices can be presented here, in favour of universality, generalisation and patterns. The example presented above illustrates a baroque approach to complexity rather than a romantic one. The implications of this are, as Law states:

if we lose the visions and the hopes of romanticism we also lose its blind spots. Other realities, questions and methodological or political possibilities are brought within the conditions of possibility. (Law, 2004a:10)

This quote highlights how 'blind spots', generated by automation and deletion of practices, prevents other possibilities for being to be considered; this also leads to 'missing a trick'. For example, when Cohort 2 were told about workplace practices on insulin prescribing, these were presented as standard procedures with a number of requirements for recording. However, through carrying out the SLISP, the students needed to handle records, find information, walk around corridors and up and down stairs, use the buzzer system and the bleep system, all in order to prink off stickers for their SLISP. It would not have been practical (or obvious) to the clinical and training lead to talk the students through all this, but this is what the students experienced. In many workplace practices, procedures become well-honed and certain activities forgotten. Like the woman in the box waiting to be sawn in half, there is more to do than wait; there is work, action and performance. In terms of symmetry, experienced staff produce their own hierarchy of what others need to know about the process, foregrounding what has been judged by them to be important, producing an asymmetric approach. It is the job of the ANT researcher to attend to detail to see what has been overlooked and to make this visible. In Chapter 8 the analysis goes further, to explore which points become more powerful, and the decisions that are made to produce dominant practices. In the next example, a process model demonstrates how procedures are reduced in this way, mirroring Law's concerns about representation (Law and Singleton 2003).

### **7.3 Anecdote 3: pedagogies of improvement science**

#### **Online practices**

In Chapter 6, networks of practices were described in relation to the connections with improvement science methodology, particularly in relation to the IHI practicum paperwork. The IHI paperwork had strong effects for Cohort 2 and how they conducted their SLISP. Decisions were made at the start of the project relating to how the students engaged with the online resources, and these were outlined in Chapter 5. This section extends the practices of Cohort 2 and how symmetry, rather than a privileging or compartmentalisation of humans and non-humans, helps to draw out specific insights. This augments the example from Chapter 5 and leads to a more in-depth description of learning and knowledge.

The students from Cohort 2 were required to submit an electronic report at the end of their four-week placement. They were working towards a collective project, but needed to submit the same report individually to the IHI Practicum in order to be individually accredited. At the start, the students needed to register their project and submit an IHI Charter, outlining what they intended to do. The final submission had to include PDSA cycles, a run chart, a process flow-diagram, a cause and effect (fishbone) diagram and a final report (Appendix 3, Figure 6.7). All the required templates were available electronically. The reliance on electronic forms meant that the practice of carrying out the SLISP was entangled in electronic equipment and practices. The configurations of equipment affected learning and the places where the SLISP was carried out by the students. For example, the students spent a lot of time in the ‘departure lounge’ where they could sit together with a laptop, teaching rooms, and the computer lab. In the computer lab, the students were able to sit in a row and all work on the same document at the same time using Google Docs. In the teaching room, the students could all see a screen and what was being written. For example, Lee and Taylor worked together on the process diagram (Figure 7.3) for the IHI report.

Fieldnotes, 26<sup>th</sup> November 2015, Book 4, page 1:

Big screen so we can all see. [Lee] logs into BMJ project and adds [Taylor] as a member then [Alex] QI Insulin project.

Call up Process Flow Template on BMJ. Moves table and chair so [Lee] can reach keyboard comfortably and look at screen. The keyboard is connected by a cable. Not wireless.

They can add into the image using boxes, text & arrows. [Lee] explains the admissions procedures: minors, majors, paed, resus.

[Taylor] looks up the process model that [Lee] put up previously on [her/his] phone.

While [Taylor] looks (discovers there is no service) [Lee] uses the drawing toolbar to see if shapes can be added. They can. So they use the shapes instead of words in the diagram to denote roles.

In this situation, the electronic equipment is setting the conditions of possibility, and this is also influencing practice by the movement of the table and chair; cables restrict the position of the keyboard, there is no service on the main PC. Lee uses a phone to bring up the process model, and Taylor uses the keyboard to bring this up on the screen. Practices are focused on what comes up on the screen. The drawing toolbar allows for shapes to be used in the diagram as a substitute for text.

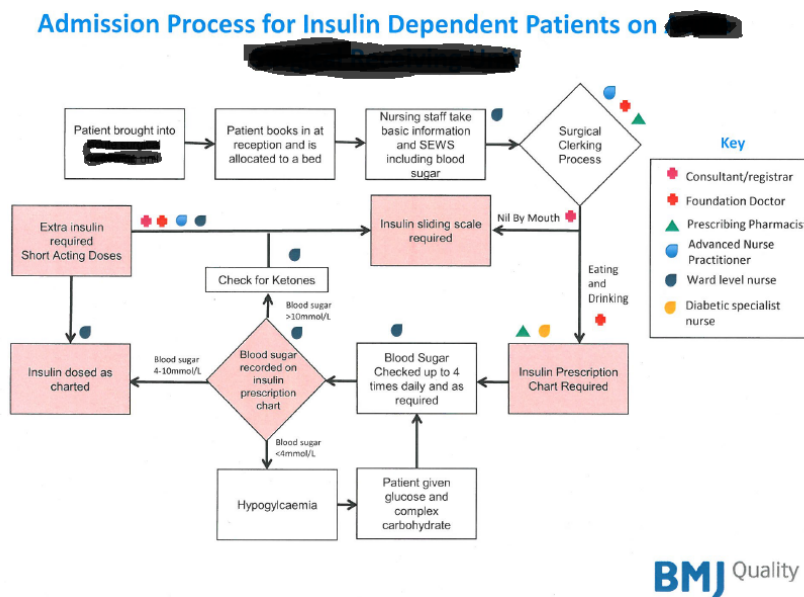


Figure 7.3: Electronic process diagram



As the two students continue to complete a process diagram, Lee introduces other equipment:

Fieldnotes, 26<sup>th</sup> November 2015, Book 4, page 3:

[Lee] uses flipchart to draw out what [s/he] thinks the process model should look like. [Taylor] stands and points to shapes on the screen to say where [s/he] thinks things should go.

The two students stand and sit as they look at different parts of the process model on the screen. In this situation, the screen, keyboard and flipchart create forces that shape where the students sit, stand and position themselves. In addition, the assemblage of materials that allows for the process model to be worked on (the computer equipment, internet, software, flipchart, pens, tables and chairs) are located in a room (teaching room) in an area of the hospital away from the wards, but connected by corridors and doors. In spatial terms, the assemblage of materials and humans (students) occupy the same proximate space. In temporal terms: booking the room, walking to the room, setting up the equipment and spending time drawing the process chart using software, all impact on the learning practices around the SLISP. Another observation that could be made is on the process model itself and how this produces a cartographic representation of the process. As Law and Singleton (2003) discussed in their exploration of mapping trajectories, representation is not neutral, and necessarily makes epistemological and ontological assumptions. In the case of the SLISP, a final process map was agreed upon by the students, but this was constructed with negotiation and compromise, and shaped by an assemblage of materials.

*How the locker became a force to be reckoned with*

Another actant that created unexpectedly strong effects in the network was the locker. The pharmacy students were studying at Hanton University, almost 70 miles away from the hospital, so had to commute and were reliant on trains and buses. To get to the hospital from the train station required a bus ride of 20 minutes or more, so, however long the train took, the bus would add time to the journey. This meant that Taylor and Alex found it difficult to arrive at the hospital early or to stay late. Their commute was at least two hours each way and they were both reliant on connections. Lee was living

near the hospital and had a car, so was better placed to come in early or stay late. Cal, one of the key contacts, explained the rationale for having students from different disciplines and universities on the same team:

Interview with Cal (21/01/16) page 3: Rationale for project

We have been striving for the last while to try and do student projects that are multi-professional, but it's been very, very challenging for us. And that's why we probably, we had a group of people from [Hanton University] who were really keen to make this work. So rather than working with our own university, we went for this chance to actually look at ... not just improvement, but also, how could we do that in properly mixed inter-professional teams.

Lee was based at Simford Hospital and was allocated a locker in the locker room for medical students. Lee shared the locker with Taylor, Alex, and myself, although it was not big enough for everyone's belongings. To do so, Lee shared the door code with us and also left the key in a pair of shoes which were left on top of the locker, so that the other students could get access when required. At first, Taylor, Alex and myself put valuable items in Lee's locker. However, because Lee also needed access, sometimes Lee would hold on to the key. The group would post messages on Slack to say where the key was, who had it and who needed it next. The other students and I used the locker room to store backpacks and coats but took equipment (iPads and valuables) with us. It was against the code of conduct to walk around the wards with big bags and coats, so we all tried to keep what we had with us to a minimum. We were all reliant on Lee to use the locker, as this was their allocated space. Some tensions arose in the group. At the start, Lee set up the online groups and was highly conversant and skilled on using the applications. However, the other two students did not have the same experience and were unsure about using these. Lee persisted with the idea and the other students learned how to use the applications; these became the main means of communication between the group members. The electronic format necessitated electronic equipment – but this required safe storage; the locker was not big enough or easily accessible, despite efforts by the team to co-ordinate where the key was being kept.

In research informed by psychology, this might have been interpreted as a clash of personalities or explained as individual behaviours working in a group. However, the analysis through ANT would be as a network of humans and non-humans as described above. Lee's personality would not necessarily have been purely down to psychological factors, but could also be explained through the discipline they worked in.

Cal Interview (21/01/16) page 15: What doctors are like:

You find that, not automatically, but in many situations, doctors will take over.

The expectations of a doctor are different to those of a pharmacist and these are reflected in the training they are given and how they are treated by staff. Lee would be expected to take charge of intense situations and to possess qualities to be relied on to step in. Being a student of Simford, it was an expectation that Lee would be able to organise work spaces for the other students and show them around. However, analysis using networks has identified the locker to be a powerful actant in this network, creating forces and effects that influenced the way the group went about their project. The ambiguity over access to the locker affected what Taylor and Alex left there. Although Lee was as accommodating as possible, there was still only one key that all three students required access to, and also limited space. Taylor did not bring in a laptop, partly due to this arrangement, and consequently all electronic work was done using Lee's laptop. The reliance on electronic formats was reinforced throughout the project through online forums and sharing sites. Returning to the questions at the start of this chapter, the assemblage of materials required to produce the electronic rather than manual format of the IHI forms ultimately shaped the practice of the SLISP and affected the learning that emerged.

To analyse the agency of the locker in more detail, I followed a suggestion by Latour under the pseudonym Johnson (1988), of drawing up a table where one column lists all the effort that would go into a task if a certain object (in this case, the locker) was not there, thus demonstrating 'tiny efforts balance out mighty weights' (Johnson 1988:299). In the case of the locker, if there were no lockers, students would have to carry things around with them, and make sure that these things did not impede work whilst on the

wards; they would also be more likely to lose things or have things stolen. This exercise illuminates the status of the locker and other things within practices. The students from Cohort 2 occupied different learning spaces such as the main concourse, teaching rooms, the locker room, the library and the pharmacy offices. This movement made it more important to have somewhere to store things and not to carry them about. The locker network will also be analysed using multiple worlds. Analysis using a network view demonstrated a stable network of electronic devices and online tools which facilitated a way of working to accommodate commuting distances and out-of-hours working. However, this configuration produced a specific reading of the SLISP that might have looked very different in different circumstances.

### **Anecdote 3 insights: inviting practice**

The choice at the start of the project to complete the forms in electronic format shaped how the SLISP was carried out by organising learning spaces where PCs and internet connections were available. Working as a team on the electronic forms affected things such as: how the electronic equipment was used and by whom; who contributes to the online discussions; how documents are merged; and, how conflicting ideas are represented electronically. The electronic format created conditions of possibility through the materials, and this was illustrated through working in rooms where materials were available such as Wi-Fi, screens, keyboards and cables.

## **7.4 Conclusions: symmetry and learning**

In this chapter, three examples were explored, guided by the ANT principle of symmetry. This first example drew attention to the material configurations of paperwork and equipment around the antibiotic story, and how this affected the practices of the SLISP. Specifically, the configuration of materials shaped the practice of collecting information by manoeuvring objects such as clipboards and ringbinders; walking up and down the ward; and reading and recording numbers on the forms. The second example looked more deeply into the assemblages that came together to produce a sticker, and the forces and effects that impacted on the SLISP project. The third example looked further into the electronic assemblages of the IHI practicum and how this affected the pedagogies of improvement science. Traditional concepts of professional learning concentrate on skills acquisition, personal attributes and the growth of knowledge which can be measure and

evaluated (Mulcahy 2014). But what does learning look like as a sociomaterial assemblage? This chapter highlights how learning is relational, with the focus on ‘associations or connections or relations through which matter and meaning, object and subject co-emerge’ (Mulchay, 2014:56). A truly symmetrical account might come from the point of view of the object itself (for a literary example of this, see Parker, 2016). However, I would argue, following Mulcahy (1999:81), that, ‘I came to understand that the tale I was telling of my network was complicit with the tale it was telling of itself’. In other words, the descriptive account is entangled with the fieldwork, and not a layer that can be analytically separated. In my research, I drew out details in fieldnotes and accounts that included materials and described how these shaped practice, such as working in electronic format. The anecdotes cited this chapter show how decisions can be made in the workplace that perform a particular type of reality. As Mol (1998) argues, if practices shape reality, then it follows that multiple practices lead to multiple realities. Choices and decisions are made as to which reality to perform into being, which is referred to as an act of ontological politics. The decisions made regarding which realities to perform need to address: what is at stake? In the case of SLISPs, an ‘improvement’ is an enactment of practices where the improvement might be evident in some practices but not others. The next chapter explores multiple worlds and ontological politics, to bring further insights from the anecdotes.



## Chapter 8: It's not a different perspective, it's a different world

## **Introduction**

In Chapter 6, I described networks using two approaches: 1) I followed actors in the data to help me to navigate and construct the anecdotes; through this I identified points of translation, and the relational forces and effects that occurred when networks came together. 2) After following the actors, I became more sensitised to connections and associations, and to relational aspects of my fieldwork. I then focused on the concept of symmetry as an additional analysis tool to explore my research in a different way to applying the concept of networks. As Sørensen (2009) remarked, the classic ANT network metaphor is not always the best 'fit' for some examples, as the emphasis on relationality and connectivity can become restrictive. Symmetry can help to explore 'spaces or blanks beyond networks' (Fenwick 2011:98). Alternative metaphors, such as assemblages, describe the data in different ways. In this chapter, I explore the concept of 'multiple worlds' (Law 2004b; Mol 2002). I start by identifying ambivalences and ambiguities in the anecdotes which might otherwise be smoothed over or discounted as atypical. Troubling these enables the exploration of multiplicity and conditions of possibility. As Fenwick and Edwards (2012:157) remark, 'Dwelling in ambiguity is about confronting and allowing multiplicity'. Shifting the focus onto ambivalences and multiple worlds enabled differences in the data to be investigated rather than reconciled, and enabled a more detailed exploration of learning and knowledge. The anecdotes in this chapter question how difference, ambivalence and multiplicity relate to education, and how these concepts can illuminate learning and knowledge during the practice of SLISPs.

The concept of multiple worlds describes how meaning is contingent in different practices. The implication is that multiple enactments can be referred to by the same name, but are manifest as different things. For example, the label 'illness' (Bleakley 2012) or a specific illness, such as anaemia (Mol 1998), could be viewed as a single 'thing'; but when different enactments start to become evident, this can either be explained as different perspectives on the same thing, or as multiple different things (pluralism). The concept of multiple worlds provides an alternative by saying that there are multiple enactments around, for example, illness, and these enactments create their own realities, but without fracturing into many separate entities. Exploring how meanings are experienced, rather than defining specific meanings, can be problematic. Meaning can be in flux, oscillating between extremes (ambivalent) or unclear



(ambiguous). Phenomena that were presented as singularities in my research (such as improvement science) were found to have ambivalent meanings, suggesting differences that were hidden behind a single term. I started by exploring ambivalent and ambiguous meanings in the data, and reflecting on my experiences in the field. Because a praxiographic approach to the ethnography was taken, following Mol (2002), this was conducive for exploring multiplicity and:

allows us to investigate the uncertain and complex lives of objects in a world where there is no closure. Where, will-nilly, there is no singularity ... it allows us to investigate the multiplicity of those objects, the ways in which they interact with one another. (Law 2004b:59)

Mol's praxiography (2002) investigated the enactments of atherosclerosis, and how it was possible to have multiple enactments of the same thing and yet still function together to achieve patient care. The act of unfolding ambiguities and ambivalences in the research data, in the following example, presented questions relating to which decisions were favoured over others: an act of 'ontological politics' (Mol 1998). For example, finding a 'common language' in improvement science involves favouring some meanings over others, meaning which is contingent and connected in actor-networks. The rationale for this trajectory, following (Mol 1998; 2002) and Law (2004b), is that reality does not precede practice. If we accept that there are multiple practices, and that practices produce reality, it follows that reality is also multiple. Following this logic, there are options between different versions; however, some options will be more favourable than others. This introduces power as a network effect in the choices between options. As Fenwick and Edwards (2010:33) put forward, 'Multiple ontologies are not equally powerful and they are themselves network effects'.

In other words, reality is a network effect and everything exists in relation to what it is associated with, and some associations are stronger than others. This raises the question: what is at stake when one reality is favoured over others, and who benefits? Ontology relates to the conditions of possibility. These are different for an engineer and an artist, for a doctor and a pharmacist. For example, a painting of physical objects by the artist M.C. Escher presents a different set of possibilities than the physical objects themselves.

Reality is shaped by practice, and this ‘shaping’ is active and political. There are two main ideas I draw from in relation to ontological politics: regulating difference and multiple membership. Regulating difference (Law 2004b; Mol 2002), as discussed in Chapter 3, relates to the ways it is possible for worlds to coexist. Multiple membership (Star 1990) refers to the way a single entity can belong in different worlds at the same time.

In this chapter, I continue to explore the anecdotes from Chapters 6 and 7. The first anecdote expands on the investigation in Cohort 1 of the ‘antibiotic story’ using the prescription chart and gentamycin form. This chapter shifts the focus from the gentamycin form as a network, towards the worlds that collide and overlap from the multiplicity of the measure of ‘duration’. The record of duration encompasses multiple practices of prescription, administering and review, and is recorded on the prescription chart; although there is protocol relating to the way duration is recorded, this is sometimes deviated from. The second anecdote follows Cohort 2’s SLISP, this time moving on from the forces and effects of the sticker, towards an investigation of how implementing the sticker on the ward became an entry point into how clinical space is conceptualised. The third anecdote draws from multiple worlds to further explore the pedagogies of improvement science, and how the idea of the SLISP can be challenged as a singularity. The questions in this chapter relate to the way that multiple practices help the students to understand that working practices are not as straightforward as identifying an improvement and then implementing it through a SLISP. The chapter proposes that alternative meanings do not always need consensus, and that multiple enactments can exist side by side. The chapter also challenges ‘the way we do things’ is not always directed by protocol but is also influenced by the power, professional judgement, authority and other effects influencing political decisions; decisions and choices which are negotiated, challenged and contested, and how meaning is contingent to different worlds of practice. To explore these issues, the questions asked in this chapter are: how are different enactments related? How do they hang together? ‘How do they add up, fuse, come together?’ (Mol 2002:55). Which reality ‘wins’?

## 8.1 Anecdote 1: antimicrobial prescribing

### The multiplicity of ‘duration’

This section focuses on how Chris encountered ambiguity and difference when attempting to record a seemingly straightforward piece of medical information. The information related to the duration of time that a medication (in this case, an antibiotic) had been prescribed for. The requirements of the protocol are that the prescriber records when the medication is to be administered and for how long. However, the prescriber might not be working with that particular prescription to the end of its course, so decisions regarding whether to continue the medication, stop or change, are sometimes made by another clinician. A variety of roles are connected to this recording: doctors, registrars, consultants, nurses, and pharmacists. As mentioned at the end of the last chapter, different roles perform different practices that might include the same objects. In the case of recording duration, different members of staff use the same paperwork but for different purposes. The nature of these differences was explored in an excerpt in Chapter 7, where a situation signposted to differences in practices between a nurse and Chris:

Fieldnotes, 14<sup>th</sup> October, 2015, Book 1 page 40:

Nurse puts clipboard back and it slips, clatters to the floor. [Chris] picks it up, the papers have come out. Nurse turns around and jokes “Every time!” and laughs. Puts board back but it won’t stay. Replaces it on floor.

The nurse and the student were handling the same paperwork for different purposes. In the above quote, the same paperwork and clipboard are handled by the nurse and then Chris, but the practices of the student and the nurse peel off into different worlds: the nurse handles the clipboard to trigger a set of practices to care for the patient, and the student picks up the clipboard to investigate how antibiotic medication has been recorded.

In the case of recording ‘duration’, Chris detects an uncertainty, which flags up an ambivalence in working practices and highlights the tension between professional judgement and protocol. ‘Duration’, recorded on the prescription chart, is part of the ‘antibiotic story’ example described in Chapter 6. When a medication, including an

antibiotic, is prescribed to a patient, the prescriber<sup>16</sup> is required to record certain details. The dose is recorded, time of administration, when the patient was started on the drug, how long they are required to continue on this (the medication plan), and when the drug needs to be stopped or reviewed. Recording duration at first appears to be a simple act of writing a number in a box, but as Chris from Cohort 1 realised, this is not always the case.

When Chris collected data for the PPS as part of the SLISP, 'duration' was included as part of the baseline data for each prescribed medication. At first, the student put together a form to collect the data, a PPS (Figure 8.1). This was based on what the student decided to collect to investigate antibiotic prescribing and to build the 'antibiotic story'. 'Prescription' refers to the act of identifying a suitable medication for treatment, which involves: seeking a diagnosis; taking samples for testing to the laboratory; obtaining results; and then calculating doses and duration. The act of prescription also draws attention to power and authority; many different roles can seek qualifications to prescribe but the decision on prescription is usually deferred to the consultant or registrar who has greater authority. Staff rotation and shifts create effects in how duration is recorded: the clinician participates in a handover, and is required to take on the prescription decisions made by other staff.

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<sup>16</sup> The prescriber is usually a junior/Foundation Year 1 or 2 doctor, registrar or consultant; with the specialised training, an Advanced Nurse Practitioner or pharmacist can also prescribe.

Date of Survey				Patient Age			
Ward				Patient Sex			
Antibiotics	Date Started	Route	Dose	Frequency	Duration	Indication	
1.							
2.							
3.							
4.							
5.							
						Yes	No
Is the indication documented for all antibiotics?						<input type="checkbox"/>	<input type="checkbox"/>
Is the duration documented for all antibiotics?						<input type="checkbox"/>	<input type="checkbox"/>
Is there a plan in place?						<input type="checkbox"/>	<input type="checkbox"/>
If there is a plan in place, what is it?							

\*ND Not Documented

Figure 8.1: Version 1 Point Prevalence Survey

Chris's Point Prevalence Survey (PPS) (Figure 8.1) had two boxes (yes/no) next to 'Is the duration documented for all antibiotics?' If duration was documented, the 'yes' box would be ticked. Duration was recorded on the prescription chart. The prescription chart is an example of how the patient is enacted in practice. Their records, which relate to their treatment history and status, are not only diffuse both in location and in the ordering of information, but inhabits different worlds. Learning is enacted in the location, selection and interpretation of these notes, as described in the 'antibiotic story' in previous chapters. Chris encountered ambiguities that were not expected. The processes all seem straightforward, but in the workplace these are entangled and operating at different levels. For example, the prescription chart was referred to by different names, such as Kardex and X-PAR (X health board Prescription and Administration Record). Different staff members used different names for the same form. This may have been due to the different practices prompted by the form. For example: doctors prescribe, nurses administer, and pharmacists check medications. Recording duration is important, as the doctor needs to know when the patient can be reviewed; if 'day 4' is recorded, then this does not indicate when the review is due. This information is necessary for the handover, to let other clinicians know why a medication has been continued, stopped and how long it is to be administered for:

Interview with Mac, 11/11/15 Page 4:

... once something's prescribed, it takes an active input to stop it from being prescribed. So if you don't do anything, it will just carry on. And the nursing staff will keep doing it. So it takes an active action to go and say, actually this has been on for a week, what are we doing about that? Can we stop that? Can we change that? But if you don't have anybody necessarily querying that, if you don't do anything it will just stay on there and carry on. So it requires input to do that.

Boxes for recording 'duration' are indicated on the prescription chart. However, on visiting the ward, Chris found that information regarding duration could not be collected as anticipated. I recorded this difficulty in my fieldnotes (below). This marks the first stage of exploring ambiguity, both for the researcher and the student.

Fieldnotes 23<sup>rd</sup> September 2017:

Some notes on the [prescription charts] are difficult to interpret – lots of different [Anti-Microbials] with different durations ... Only current duration from sheets – not sure at this stage what needs to be recorded ... 24/9 date format confusing in duration box (usually as 1/7 (week))

At first, the idea of 'duration' was referred to by the student as a singularity, categorised in the same way as the type of antibiotic used. But the action of going into the ward with the intention of ticking a box then became a complex undertaking. The above quote is one example of when Chris encountered ambiguity in recording duration. The standard format is [day] 1 of 7, recorded as 1/7. However, in the example cited, the numeric could be a date 24/9 (24<sup>th</sup> September) or a duration recorded as the ninth day of 24. On another occasion during the fieldwork, a nurse described how a small, yellow sticker was being used on the prescription chart to mark when that particular medication was required to be reviewed:

Fieldnotes, 23<sup>rd</sup> September 2015, Book 2 page 4:

Ward nurse demonstrates sticker and [prescription chart]; show that it has been reviewed ... [my reflective note: This is the way we do things] ... Nurse explains the card and stickers; culture change; education and policing; gives authority to make decisions.

The nurse in the above extract presented the process as a way of changing the culture, process and authority of recording prescribed medicines. The nurse presented duration as a process whereby the date for reviewing the medication is the most critical, and that nurses should have the authority to enable them to prompt the review to take place. However, when the yellow sticker<sup>17</sup> was mentioned in a later meeting, a consultant was less than enthusiastic:

Fieldnotes, 23<sup>rd</sup> September 2015, Book 2 page 7:

[my reflective note]: Was a bit dismissive about stickers. Explained they need to be used properly as part of the process.

For doctors, the prescribing is the start of the process, but the duration is something that continues over time, through shift handovers and staff rotations. The duration is decided at the start, regarding when to start the treatment and how long this should continue for. However, the decision might be changed if the patient is not responding as anticipated. Making the decision to stop or continue a medication sometimes requires extra work through testing the patients' levels, and perhaps a decision on switching from intravenous to oral or vice versa; it also requires an indication on the handover note to justify stopping a medication. These extracts illustrate the complexity that unfolds as Chris attempts to record a simple 'yes or no' on the PPS form, indicating if the duration has been recorded in line with protocol.

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<sup>17</sup> It must be noted that the yellow sticker was demonstrated by a nurse on a ward that was not included in either cohort, therefore it was only demonstrated in the fieldwork and not seen as part of practice on the other wards.

The student decided to redesign the PPS form with notes to indicate the specific numeric sought (Figure 8.2).

<b>Patient Age</b>		<b>Indication for antibiotics</b>				
<b>Patient Sex</b>						
<b>FROM TPAR:</b>						
<b>Antibiotics</b>	<b>Date Started</b>	<b>Duration (so far)</b>	<b>Route</b>	<b>Dose</b>	<b>Frequency</b>	
					<b>Yes</b>	<b>No</b>
<b>Is the indication<sup>1</sup> documented for all antibiotics?</b>						
<b>Is the current duration<sup>2</sup> documented for all antibiotics?</b>						
<b>Is "yes" for current duration, is this correct compared to TPAR?</b>						
<b>Is there a plan<sup>3</sup> in place?</b>						
If there is a plan in place, what is it?						
Comments						

**\*No patient identifiers will be recorded but a reference should be used to ensure no patients have been missed or their data collected twice.**

<sup>1</sup>**Indication:** If an infectious process is documented in the notes and the antibiotics prescribed is related to this infection choose "yes". If antibiotics are prescribed without documentation of a possible infection and there is no explanation as to why the antibiotics have been prescribed choose "no".

<sup>2</sup>**Current Duration:** The current duration is the number of days the patient has been receiving the antibiotic so far. This will be based on the most recent entry in the notes and compared to the duration in the PAR to ensure accuracy.

<sup>3</sup>**Plan:** The plan should consist of both a duration and an action to be taken after the selected duration (e.g. give x for 3 days then switch to oral). If awaiting results of a test the plan should consist of when the results should be checked. If a review is required before a decision to take any actions can be made then the date of the review should be documented.

ONLY INCLUDE CURRENT ANTIBIOTICS. ANY ANTIBIOTICS THAT HAVE ALREADY BEEN DISCONTINUED SHOULD BE EXCLUDED.

*Figure 8.2: Version 2 Point Prevalence Survey showing much more added detail relating to how antibiotics are recorded. 'Duration' has been changed to 'Current Duration', which is explained in the description as the number of days the patient has been receiving the antibiotic so far.*

In the student's second form, there is more detail of what is meant by duration. There is also, on both forms, a yes/no box to indicate whether duration has been recorded. This demonstrates how Chris handled the ambiguity of 'duration'. Again, this became a



challenge for the student. The information regarding antibiotic review, planning and possible switch from intravenous (IV) to oral are all implicated in the recording of duration.

Interview 2 with Chris, 21<sup>st</sup> October, 2015:

Because what I'm finding right now is that it's quite difficult to tell whether or not I should be, oh yes, they've wrote down the total duration because they might not have said anything for the first week and then on day 8, they've said, oh yes, 5 more days ... It's like, yes, there's a duration now, but there wasn't for a whole week. So, is that yes or no? So I'm going to have to clarify all of these grey areas as well, so that they're quite clear ... And it gets very complicated!

The student identifies the complexity as 'grey areas' and seeks to clarify these with the supervisory team. This highlights an important aspect of learning in the anecdote. In talking about their confusion, the student becomes more confused.

Meeting with Chris and two supervisors, 14<sup>th</sup> October 2015:

Chris: Yes well, I found so far that ... because [consultant] was saying that so far she's told them all these indicators so they're now all aware that they're supposed to document duration. But I think there's been a mix-up somewhere, because they're all documenting duration 'so far' instead of 'total duration'. I double checked with the pharmacist and she said it's definitely how long they're going to give it for, not what day they're on. So I was on a ward round today and they were, "Oh so that's day 7," so I was like ... I don't really know whether to say something the now, or (laughter) it might be something that they tend to do as well ... they would say, "Oh yes, this is day 5," and then they're supposed to go on and say, 'For 7 days' ... I don't know ... I didn't want to say, 'Oh, don't write that,' just in case that's something that they also write ...

Supervisor: Well you'd want them to write, 'day 5 of 7', wouldn't you?  
Just so it's clear!

Chris: So, all the ones that haven't documented the duration have actually documented 'so far' durations. So they've been scored as 'no', but ... I think they think they have. So I'm going to go speak to [consultant].

Supervisor: I think I would make a note of that when you see it ... so if the answer's 'no' then it's because there's nothing, when what they've actually recorded is how long the person's actually been on it.

In this quote, the supervisor appears to make a clear decision as to what could be regarded as compliance with protocol when recording duration: 'day 5 of 7'. However, the student goes on to say that there are 'so far' documented durations; not in the correct format, but with the correct information. It is then agreed that non-compliance is where nothing is recorded as opposed to a 'so far' recording which is accurate but not compliant with protocol. The student reflects this in their second draft of the PPS (Figure 8.2). It is important to note that, as well as the prescription chart, Chris looked at other paperwork, such as the handover notes, to investigate why duration was recorded as 'so far' instead of being compliant with the protocol. This presented an interesting rift between adhering to protocol by recording duration as 'day 5 of 7' and the reluctance to exercise professional judgement by stopping a medication – possibly because the decision was made by a different doctor before handover, or possibly because of the additional work that is required to switch from intravenous to oral medication, or obtaining test results to stop a medication. As Mac noted in the interview earlier in this section,

... once something's prescribed, it takes an active input to stop it from being prescribed ... if you don't have anybody necessarily querying that, if you don't do anything it will just stay on there and carry on.

There was also the example of the nurse describing how the yellow sticker enables nurses to have the authority to prompt a review, thereby strengthening protocol, and how the consultant was dismissive of this, suggesting that these might not be used properly. These

examples illustrate the different processes involved in recording duration across roles, handovers and staff rotation. Rather than dismiss these as different perspectives on the same thing, or as a deviance from protocol that can be corrected, it might be more fruitful to explore the different practices and enactments of duration that might be considered as multiple worlds.

### **Roles in prescription and administration practices**

From the examples in practice given above, what can we say *is* 'duration'? Using a praxiographic approach, the 'is' in this sentence is open, contested and local. It might be more accurate to say that duration is enacted differently in different practices; and although these are incommensurable, they operate side by side. For a nurse, duration indicates if and when a drug is to be administered. For a pharmacist, duration is a recommendation that is to be signed off by the doctor. For the doctor, duration is to do with when they intervened with the patient on their journey, and what they record for the next shift. For Chris, the medical student, duration is a specific recording procedure that takes into consideration a treatment plan, a record of what has passed, response to treatment, and when the drug is to be administered or stopped. Duration is not simply an indication of whether protocol has been followed, as was originally anticipated by the design of the PPS (Figures 8.1 and 8.2).

For the nurses, duration is something recorded and signed on the prescription chart which is referred to during medication rounds. The administration of medications is usually carried out by nurses, who administer at particular times in the day using a medicines trolley. Some of the photographs I took during my research illuminated the sticking together of practices. As mentioned in Chapter 4, I used the 'remove background' function on PowerPoint on one of the photographs from the ward, which created an image of the medicines trolley with a prescription chart. The medicines trolley/prescription chart 'hybrid' (Figure 8.3) helped me to conceptualise how practices are stuck together, and to think about how worlds were shaped. For example, the doctors associated the prescription chart with the patient notes and test results, predominantly during ward rounds; the trolley/prescription chart hybrid was not part of their practices. The use of the prescription chart illustrates how the practices of prescribing, recording and administering hang together and operate side by side, despite their differences. As described in Chapter 3, Law (2004b) draws from Mol's (2002) praxiography to describe

how differences are regulated in ways that reflect either different world coexisting, or one becoming dominant over another, or a narrative being introduced to join the world together. As has been demonstrated, recording duration is carried in different practices which are held together through translations. However, the conversation with the supervisors might be more congruent with rationalizations, as agreement is reached regarding what to record, with differences explained away through dialogue. Berg and Goorman (1999) present this through the contingency of medical information, and Allen (2013) also highlights different practices involved in the Integrated Care Pathway.



*Figure 8.3: 'Remove background': trolley-Kardex hybrid*

### **Anecdote 1 insights: more than one and less than many**

Collecting background information for the SLISP began with a straightforward PPS form with one 'yes/no' box (Figure 8.2). The process of ticking the box led to oscillating forces, tensions and 'strain' of ambivalence (Fenwick and Edwards, 2010) as the recording of 'duration' revealed a multiplicity through different practices. The practices of prescription, administering and review created different enactments of duration that were incommensurable, yet operated side by side. Differences were regulated through translation (in practice) and rationalization (in discourse with supervisors). The practices are 'more than one but less than many' (Law and Hassard 1999; Mol 2002; Strathern 2005) as they 'hang together' to perform duration but cannot be collapsed into a singularity. Partial connections (Strathern 2005) refer to the inclusion of one entity within another and vice versa, but where the entities cannot be collapsed into a singularity

(Law 2004b). This provides a way of thinking beyond binaries of 'one' or 'many'. The 'yes/no' tick box on the PPS was changed by expanding the meaning of duration to accommodate different practices; this could be imagined as the SLISP challenging the 'yes/no' binary and accepting ambiguity as part of practice. This illustrates the tensions between the requirement of improvement science to be precise and exact, and the messiness and ambiguity of practice. The pursuit of the term duration allowed for an examination of detail into the enactment of prescribing practices and how this translated into the SLISP for Cohort 1. The 'remove background' function on PowerPoint created images with boundaries around objects stuck together, rather than isolating discrete objects, which helped to envisage hybrids to 'rearrange humans and things to allow for new forms of technology, knowledge, presence and learning to emerge' (Sørensen 2009:13). The contingent nature of medical information has been explored in other studies (Berg and Goorman 1999). Studies of specific forms, such as the Blue Form (Zukas and Kilminster 2014) and the Integrated Care Pathway (Allen 2013), have demonstrated how social practices cannot be explicated from recording and translating medical information. This example has introduced an alternative reading of this phenomenon by describing how social and material practices are enacted in multiple worlds where medical information is entangled in practice. Learning was enacted in this scenario from the differences and multiplicity of recording duration, leading to a different version of the PPS (Figures 8.1 and 8.2). The decisions made by doctors were translated onto forms and into boxes, but there were differences in the way information was recorded. Knowledge was dispersed, from the paperwork on the ward, to the consultant and to the supervisors, and enacted in practice. Qualifications to prescribe assumed that pharmacists and APNs 'held' official authority to prescribe. However, prescription practices were subject to stronger forces that were not 'held' but circulated. Junior staff deferred to senior staff (Foundation Year doctors and pharmacists to registrars, for example). Staff rotation and availability also played a part; the absence of the surgeon on the ward (because they were in surgery) or the time of day also added to the dynamic movement of authority.

In a hospital setting, the implications of thinking of multiple worlds is that there are different networks of practices coming together (in this case, the term 'duration'). This means that we are not taking different perspectives on the same 'thing', but that we are paying attention to enactments producing different realities. In a broader sense, this helps

us to move away from the idea that we can measure and evaluate SLISPs as a singularity, and abstract improvement science from different networks, implanting it into others.

## **8.2 Anecdote 2: insulin recording**

The previous anecdote drew from the metaphor of multiple worlds to describe how an ambiguity in Cohort 1's SLISP unfolded multiple practices. Despite the tensions and conflicts of authority, the practices continued side by side. In the following anecdote from Cohort 2, multiplicity is unfolded through exploring physical spaces and the distributed nature of learning and knowledge through competing conceptualizations of the surgical floor and surgical wards. In this section, two stories are presented of how the enactment of space leads to multiple membership of healthcare professionals. In the first, conceptions of the clinical spaces of the ward and the surgical floor are presented a way of ordering the working space and membership of healthcare professionals. The second goes beyond clinical spaces and into other hospital spaces where corridors, waiting rooms and storage rooms were used as a site of learning for the production and implementation of the sticker to record insulin. It was important to observe practices within and outside of the clinical spaces such as the hospital ward; the ward may be considered to be the site of activity for the SLISP, as this is where the clinical practices take place, but other spaces such as the locker room became a learning space for the students.

### **1. Ward or floor?**

Early on in Cohort 2's project, the clinical lead took the students around the 'surgical floor', which can be visualised as a number of wards in a row, joined together by interconnecting doors. I found it difficult to record fieldnotes by hand during the visit, as we were walking around quickly and sanitising hands at every sink we passed. I therefore recorded reflective notes immediately after the event:

Excerpt from reflective notes, 16<sup>th</sup> November 2015:

[clinical lead] took us through the wards, through linking corridors and back doors. This gave the effect of the 'Surgical Floor', rather than segmented as distinctive wards, a mass of rooms and beds that all linked together. By negotiating around the surgical wards it gave a

labyrinthine feel which contrasted with my previous experience with [Chris]. It was disorientating and dizzying, our senses were assailed as we followed [clinical lead]'s quick steps, stopping at each alcohol hand-wash dispenser, ducking out of the way of staff, squeezing past beds and trolleys ... In [receiving ward] it was very busy and we looked at notes from the huge manila patient records ... The wards had seemed more materially populated to me, but also darker. I think it must be a thing in the hospital that they turn the lights off in the ward.<sup>18</sup> When I had come with [Chris], everything had seemed very bright, the big windows and strip lighting. When we walked around with [clinical lead] it was darker, more shadows, the lack of light making everywhere seem more cluttered, more things hidden. The darkness seemed to change sounds too, everything sounded more muffled, softer. It was probably for the comfort of the patients and didn't seem to hinder or bother the staff.

This extract illustrates how the same physical space had been enacted differently at different times. The concept of the ward presents segments that are separated by doors, a main entrance and the position of the nurse's station as a form of reception desk. The notion of the same space as part of the surgical floor opens up the space, allows for flow through the corridors. Mol (2002:55) describes the enactment of knowledge in hospital spaces:

... the building isn't divided into wings with doors that never get opened. The different forms of knowledge aren't divided into paradigms that are closed off from one another. It is one of the great miracles of hospital life: there are different atherosclerosis in the hospital but despite the differences between them they are connected.

The worlds of the ward and the floor hang together through use of the doors: the wards keep the doors shut, the floor opens them. The doors are not locked and it is not

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<sup>18</sup> I was later told that the lights were turned off in the wards at certain times to allow patients to rest. Our visit took place early afternoon.

prohibited to move through them, it is working practices that affect how the doors are used. Other factors are the trolleys, which are mobile; the beds on wheels; and the corridors. At each entrance/exit there is hand-sanitizing gel, which invites the practice of movement by providing a way of sterilizing the hands at each point. If the gel was not there, staff could not sterilize their hands, which would not be considered safe. Therefore, the position of the gel grants permission for traversing the floor through the back doors instead of the main entrance. The doors were not locked at the back of the ward, enabling staff to pass through from one ward to the other, as the clinical lead (a pharmacist) demonstrated. However, staff rotation and procedures also impacts on how these realities 'hang together': the junior doctors ascribed to a ward for a period of time, and the nurses employed by the ward, would not have cause to enact the floor in the same way.

Staff rotation for junior doctors was usually two months on one ward, whereas the pharmacists were placed for a longer period of time covering multiple wards on the same floor. Nurses are employed by the ward. The difference in practices influenced the way different health professionals conceptualise the ward and the floor. For example, when I arrived on a ward I sought permission from the Senior Charge Nurse as this person was considered to be in charge of the ward, even though they were not necessarily the most senior staff member present on the ward. From the observations with Cohort 1, explorations of different wards took place by entering and exiting through the main entrance, and no attempt was made to use back doors. The connection between different enactments of the clinical space and clinical roles was emphasised by Mac (a pharmacist):

Interview with Mac (11/11/15), page 6:

... we don't have enough pharmacists to have one pharmacist per ward, is the bottom line ... we just don't have the resource to do that. So we spend some time on the ward, and we spend time on whichever other wards. Whereas the junior medical staff, so the FY1s and the FY2s, they are associated to one ward only ... And the nursing staff obviously will work on the one ward all day as well. So they're there the whole time, for the whole shift and on that one ward. And then they come back the next day and they're on the same ward.



The above quote from Mac highlights the role differences between medics and pharmacists. This is significant for the students in Cohort 2, as they were an interdisciplinary team. In the case of the pharmacy students, the possibilities affect the space that they enact their practices within, challenging the concept of the ward and opening this out to a floor. These enactments relate to the professional practices of the students: although the medical student in Cohort 2 was more familiar with the ward, it was the pharmacist clinical lead who enacted the floor. In terms of Cohort 2's SLISP the implications were about how they themselves, as medical and pharmacy students, negotiated spaces between wards to conduct their project. The guided tour by the clinical lead highlighted differences in the enactment of space by different professional groups that might have been overlooked if the project had been limited to doctors and medical students. The differences challenge the conditions of possibility for both professional roles by presenting the option of walking through different corridors and doors between wards. Other studies have focused on the connections between learning and inter-professional practice. For example, Falk et al. (2017) drew from Schatzki's concepts of commonality, where practices are shared and have things in common, and orchestration, where practices are different but affect each other, to describe how knowledge was shared inter-professionally. In this story, inter-professional practice is explored through difference in the way that space was enacted by Cohort 2 as they carried out their SLISP.

Clinical spaces were integral to both cohorts. Being on the ward was an important part of the project for experiencing work in the hospital. The students' experience of the wards was described in Chapter 6, which highlighted the feelings of discomfort experienced by the pharmacy students, and the familiarity of the medical students to the clinical environment. In addition to the enactment of clinical space as signposting to professional practices, this study explored the use of spaces beyond the wards as sites of learning for the SLISP. Ahn et al. (2015) presented learning spaces as sociomaterial arrangements that create conditions for learning. The next story suggests that spaces can be adapted in different arrangements for learning to take place, and that although sociomaterial arrangements affect learning, different learning effects can emerge that are equally valuable.

## 2. Learning spaces

This story describes the students' enactment of learning spaces in Cohort 2. There were no specific areas that the students could work together as a group, such as an office or classroom. The wards were the site of the improvement for the SLISP, but it was not practical to work as a group in this space. The pharmacy office was also not a viable working space because of the complicated buzzer system that would prevent access. Lee booked teaching rooms to enable the group to have access to electronic equipment, but the availability varied over the project duration. The group consequently spent a lot of time in the 'departure lounge', a meeting space for medical students, with sofas and tables. However, during break times the space became very noisy and busy. As described in the previous chapter, the pharmacy students were commuting from home and were reliant on trains and buses. Lee was based at Simford Hospital and had a locker, and had given us the door code. At first, we all used the locker; however, sometimes it was not possible for Lee to leave the key. The group would post messages on Slack to say where the key was, who had it and who needed it next.

Slack message from 3rd December 2015:

[Taylor] [/3:48 PM/](#) Sorry [Lee] whilst I'm remembering we will need the med rec forms in your locker. Can you leave them Hidden in changing rooms if you won't be in or give them to Bethan?

[Alex] [/3:54 PM/](#) Just hand out the 4 sticker sheets in pharmacy, Tried to bleep the doctor but No answer

[Lee] [/4:56 PM/](#) I've left my locker key in the usual spot

[Taylor] [/5:02 PM/](#) Thanks! Good luck tomorrow :)

In this excerpt, the 'usual spot' refers to the pair of shoes left on top of the locker. The Slack group conversation illustrates how the group connected with each other and with materials using electronic means interlaced with manual practices. The example also illustrates the differences in identities of the students and how spaces enacted identity; in this case it was not just professional roles that created differences, but affiliation (and proximity) with the host university. Lee's multiple membership as a medical student and

as a student at Simford University is demonstrated in this example. The differences continued to be played out as the students worked on their SLISP: the lack of secure locker space and reliable access for all the students meant that one of the pharmacy students was reluctant to bring in a laptop (the other pharmacy student brought an iPad which was more portable). Because the group had committed early on to completing the project electronically, the lack of hardware reduced options for all the students to participate as they would have liked. The ANT concept of symmetry would highlight the agency of the locker key in this case, which was driving the behaviours of the group. There is also an argument for the conditions of possibility of the different worlds of the students, and the ontological politics that were brought into play in the decision making around making the project work largely electronic.

Working in different areas such as corridors, waiting rooms, the locker room, the departure lounge and so on, stretched the limits of possibility as to what constituted learning spaces for the students to finish their project. A 'social solution' might be to provide the students with a base to undertake group work and leave belongings. However, by negotiating unusual spaces for working, the students were becoming familiar with the hospital as a building. The students also encountered situations that created learning effects by testing their limits of where it was appropriate for them to be. For example, on one occasion the students were berated for lurking in the corridor when a porter came past with a patient in a bed. Unguided wandering around the long corridors and up and down the stairs gave a sense of scale. For the outsider, clinical space is imagined as a hospital ward. However, distributed realities of clinical spaces hang together as corridors, waiting rooms and even the locker room. The idea of 'place' as a container for human activity (Sørensen 2009) is dissolved as the boundaries are challenged between ward and floor, clinical and learning space.

### **Anecdote 2 insights: assembling realities**

For a medical student, the conceptualisation of the ward as a discrete unit, or closed system, might limit the conditions of possibility. The patients move about between wards (with their associated paperwork), as do specialist staff such as pharmacists, physiotherapist and nutritionists, which creates an ambivalence in spatial terms. However, the nurses and FYs have a dominant presence in wards, which could make their reality more explicit through discourses of the ward and enactment of ward practices.

The consideration of physical space and who decides how the space is used, is an act of ontological politics. Conceptualising a 'floor' might broaden conditions of possibility. The concept of collateral realities (Law 2009) reimagines how space can be enacted. There is an explicit function of some of the places in the hospital: the ward is where clinical work is enacted, and where patients and workers are situated. This version of reality is explicit; the ward layout presents the ward as a unit, the reality of which is reinforced by the nurses, FY doctors, patients, bays, doors, nurses' station and so on. However, this reality can be reimagined by roles which function across wards, on the 'floor', such as pharmacists: this can be termed a 'collateral reality': 'realities that get done incidentally and along the way' (Law 2009:1). The collateral reality is performed rather than known, and shifts the focus from a singular reality to a multitude of practices which create different realities. The collateral realities of corridors, stairways, waiting rooms, rest areas and locker rooms are also brought into being by assemblages that perform multiple realities.

Sørensen (2009) warns against the idea that a particular space is a domain or container for particular roles to be enacted. In Mol's (2002) study, for example, different enactments of atherosclerosis were evident in different places, but this does not mean that the place performed a version of atherosclerosis. The locker room was performed into a learning space by the students, as were corridors and waiting areas. Choices were made at throughout the project to use electronic forms and to work together as a group, which enacted a particular world of practice and identities for Cohort 2; however, different worlds may have been possible if the choices made had been different. The choices refer to ontological politics and conditions of possibility.

### **8.3 Anecdote 3: pedagogies of improvement science**

At the start of my project, I was introduced to the idea of improvement science, and connected with the Scottish Improvement Science Collaborating Centre (SISCC). I was also a member of the Nursing and Midwifery Allied Health Professionals Research Unit Implementation Science Special Interest Group at the University of Stirling. I read and discussed current literature in improvement science through these groups, in the context of quality improvement and implementation science. Later in my project I narrowed down my area of research to SLISPs. The Institute of Healthcare Improvement (IHI) and

the IHI Practicum became a way of identifying what was 'in scope' for the SLISPs. However, because improvement science was in the early stages of being introduced to the NHS in Scotland, there was an opportunity to explore it before a universal meaning was imposed. In healthcare there is a propensity to 'find a common language' to apply to evaluations and studies so they can be compared and synthesised. However, I realised the 'scope' of SLISPs varied depending on different student professions and quality improvement projects. For staff on the ward, SLISPs were an extension of an audit, for students they were part of their work experience. For some clinical staff, SLISPs were seen as an opportunity to implement improvements in a short period of time. For the students themselves, SLISPs enabled them to lead hands-on projects in the workplace. During my research, I observed the students working with a range of staff, from consultants and clinical leads to administrators and librarians. The practice of a SLISP was enmeshed with everyday practice and real-life scenarios.

Throughout my research and following the SLISPs for Cohorts 1 and 2, I became aware of differences and ambivalences in how the projects themselves were set up and presented. At the start of my research, I understood the SLISP as a bounded, short-term project that students could lead, and which drew from improvement science methodology through the IHI Practicum Open School. However, I realised that SLISPs took on different forms, with students conducting longer projects, working in groups or leading a project alone. I realised there were different enactments of the SLISP, relating to how the improvements were introduced, managed, led and presented. In this section I explore the differences between the two SLISPs and go on to probe ambiguities in Cohort 2's SLISP. The purpose of this is to demonstrate the coexistence of the multiple enactments of SLISPs and the implications on learning. The question becomes: is consensus required as to what constitutes an improvement science project, or can different enactments coexist? And what is at stake if improvement science projects are standardised?

For Cohort 1, ambiguities were openly discussed and negotiated during supervisory meetings. Chris had been part of other group SLISPs in the past, and was experienced on the wards. Cohort 2's SLISP was a bounded project that was submitted to the IHI at the end of the project, using the IHI electronic templates and procedures. The contrast of the two cohorts highlights how projects of a different nature gather under two aspects: projects that are led by students and utilise improvement science to implement a quality

improvement. However, the degree to which the students lead the project also illustrated difference: Chris from Cohort 1 decided on the improvement and made key decisions to shape the SLISP with minimal input from the supervisory team; Cohort 2 had an improvement allocated to them by the clinical lead, and met frequently with the clinical lead and the training manager to discuss key decisions. The use of improvement science also varied between the cohorts: Cohort 2 filled out the electronic templates from the IHI throughout their SLISP; Chris from Cohort 1 considered improvement science as a 'mindset'.

One of the key contacts, Jean, presented SLISPs in a way that held open controversies and ambiguities. Jean referred more to quality improvement than improvement science, and referred to quality improvement as a particular group of people and a particular way of doing things. Jean's ideas of SLISPs relating to the IHI Practicum further opened out difference:

Interview with Jean (p. 4):

... I want them [students] to be more involved in research with the process of understanding theory and theory based interventions rather than, oh we thought this would be a nice way of doing things ... versus, OK, let's see what's out there, let's see what could fit with this particular context. So at least, a little bit more systems thinking in that sense, throughout the process of research, rather than more fragmentary based on some rigid rules and regulations from IHI ...

Jean's presentation of SLISPs was different to that of Cohort 2, whose project was centred on the IHI Practicum. However, Cohort 1 was more closely aligned with Jean's version, which could be due to having experience in doing previous SLISPs. The training lead, Cal, also emphasised the ambiguity of SLISPs:

Interview with Cal, page 4:

... there are different ways to approach things, and there's not always a right or wrong way. There are good basic principles, but I think if you've got students who are first time doing this and trying to learn,

you want to make sure that they are getting a clear message. And that they're clear on what they're doing. Because I think the overall process, as we see each time when we do this, is that the students go through a big journey. And very much, very unsettling for them because this isn't straightforward. And also their priorities and the way they plan things out, the timescales, are not always really fit within a clinical environment.

It could be said that improvement science was enacted between people and other elements. As Mol (2002) describes in the 'doing' of a medical diagnosis: 'two people are required. A doctor and a patient. The patient must worry and wonder about something and the doctor be willing and able to attend to it' (Mol 2002:23). Mol's argument is that the diagnosis is performed into being, rather than being an essential element waiting to be discovered. In a similar way, improvement science is enacted and performed as part of SLISPs. It might be said that two people are required to enact an improvement: clinical staff of the ward need to be convinced that this will improve practice, and the SLISP student has the time and commitment to attend to the improvement.

For Cohort 2, the enactment of the SLISP presented ambiguities through the PDSA cycles. Cohort 2 were sent links to the IHI Practicum, and had completed most of the modules prior to starting. The cohort met for the first time on 16<sup>th</sup> November 2015 and attended a presentation by the training team to explain the rationale for improvement science and the project they would be undertaking. The students were told that their project was more about learning the processes of improvement science (like learning a new language) and working together as an interdisciplinary team. The IHI Practicum was introduced along with all the associated paperwork. The students were told what they needed to do within their four week placement and how to submit the project at the end. The time-scale of Cohort 2's SLISP was a factor in the reliance on the IHI Practicum paperwork. The time-boundedness created a boundary for Cohort 2, where there were few resources to challenge ambiguities around their SLISP. Nonetheless, some ambiguities arose through the enactment of the project tools, most notably, what constituted a PDSA cycle. During their induction, the students were told:

Fieldnotes from 16<sup>th</sup> November 2015, page 8:

PDSA is most important; this could be talking to a staff member about a sticker: need to predict what you think the outcome will be. All need to be written up.

Later on, the students in Cohort 2 complete what they consider to be their first PDSA cycle. However, the clinical lead disagrees with their judgement:

Fieldnotes from 17<sup>th</sup> November 2015, page 39:

[Clinical Lead] disputed the first PDSA, this was more about engagement and buy-in. [Taylor] pointed out that [training lead] had a broader view on PDSA. [Clinical Lead] clarified that PDSA is about a test. Test is different from a task.

The exchange illustrates how improvement science is still open and contested through the enactment of the practices of SLISPs allow for negotiation and difference in relation to how the PDSA is carried out and what it is for. In the case of Cohort 1, PDSAs had become a 'mind-set' rather than a procedure:

Chris, Interview 1, page 8:

Well, the PDSA cycles were really useful. And I find that you do it even though you're not aware sometimes of you doing it. Because you kind of get into that mindset of: OK, I'm going to do this and I've got to plan this, and then you go try it and go: right, what should I change? And then you change it; and then you're doing it without thinking about it. So, I will definitely take that forward, but kind of make it more explicit when I'm doing a PDSA cycle, because I think it helps look at your kind of progress from where you started and what you've changed.

Chris's quote shows how the PDSA has become part of practice, rather than a form to fill in. The discrepancy about PDSAs between clinical staff highlights their different



practices: the Clinical Lead was more conversant with the operationalisation of PDSAs as part of improvement science, whereas Cal was more concerned with the students from Cohort 2 learning to use the 'tools' of improvement science. In this case neither version 'wins', as the PDSAs are targeted at different aspects of the project: test and task.

A similar ambiguity arose concerning the Run Chart and the process diagram, demonstrating the ambiguous nature of SLISPs:

Fieldnotes 7<sup>th</sup> December 2015:

The group are required to submit a run chart as part of IHI; [clinical lead] argues that there is [not] enough data to put in a run chart. [Cal] points out that it is a requirement ... [Cal] points out that the process map shows what should happen and highlights that this doesn't happen.

From a praxiographic perspective, the PDSA and Run Chart are local and connected, not universal and isolated.

The ambiguities within Cohort 2's SLISP highlighted the open and contested nature of how improvement science is enacted in SLISPs. It also demonstrates how improvement science is only taken up partially in the SLISP: the run chart, as the clinical lead pointed out, did not comprise a sufficient amount of data points to demonstrate significant change. Whilst this may be accurate in a positivist sense, Cal argues that the purpose of the run chart is for the students to become familiar with the approach, rather than actually utilising the approach itself. Cal and the clinical lead reinforce different types of realities, but these are allowed to coexist under SLISPs. The practice of constructing a run chart, although nonsensical in a positivist sense, is acceptable as a pedagogical approach for improvement science. The PDSA unfolded a debate about 'test' and 'task'. Again, in improvement science, the PDSA is required for small tests of change; however, in the SLISP, the PDSA can be used in a broader sense to describe the stages of a task. In summary, the SLISP can be used as a way of enacting improvement science, but does not need to demonstrate improvement science as a whole approach. This demonstrates that the 'improvement' associated with the SLISP does not necessarily lead to an improvement in the workplace.

### **Anecdote 3 insights: regulating difference**

In Cohort 1, Chris made decisions on the SLISP, consulting with supervisory staff for guidance. In contrast, Cohort 2 were given a project by a clinical lead and then met frequently to be given more direction in the project. The enactment of improvement science in Cohort 1 was as a mindset, which came about through experience of other SLISPs. In Cohort 2, the IHI templates formed the basis of the SLISP and were adhered to. The relation between improvement science and the SLISP could be described as a partial connection (Strathern 2005). Improvement science includes methodology, templates and guidance to be enacted, and the SLISP includes improvement science approaches. The two approaches can be included in the other, but cannot be collapsed into a singularity. A partial connection provides an alternative to the binary of one or many, by allowing more than one and less than many. In terms of the IHI and assessment procedures, it is inappropriate to say that we can compare like for like when it comes to improvement science projects: as has been seen by the two cases, projects can be highly diverse with a range of implications. However, we can say that these can exist together and side by side, rather than being one and the same thing. In terms of regulating difference, SLISPs are held together through narration in groups such as SISCC, the IHI, The Health Foundation and KIS.

The two SLISPs demonstrate that different versions of improvement science are enacted which have implications on practice. The SLISP for Cohort 1 did not rigidly adhere to the IHI Open School practices, and aimed for longer-term change. The SLISP for Cohort 2 followed IHI procedures with the aim of implementing rapid change. In terms of ontological politics, the two SLIPs were enacting different versions of improvement science that were at odds with each other and yet coexisted in practice. The implications are that different types of learning emerged from the SLISPs that were still presented as pedagogies of improvement science. There are also implications for professional learning:

students need to realise that professional practices are not stable, but changing, and that they need to be able to induce change in their professional work as part of their professional responsibility ... to be able to stage and carry out processes of change, which is important, not

least from the perspective of enhancing patient safety. (Dahlgren et al. 2012:192)

#### **8.4 Conclusions: multiple worlds and conditions of possibility**

This chapter started by exploring the enactment of multiple worlds, and different practices created ambivalence of the recording of 'duration'. Despite these different enactments, the practices 'hung together' through rationalization and translation. The example of enacting clinical and learning spaces further explored role and identity as multiple worlds. The choices made during the SLISP in Cohort 2 were examined as acts of ontological politics, where one reality prevailed over another through material assemblages (such as the locker and electronic equipment) and spaces (rooms and areas for group work). The final example presented the multiple worlds of the SLISP through the enactment of improvement science. At first, the seemingly narrow and restrictive conditions of possibility of the SLISP through the IHI Practicum were challenged through ambiguities in the structure and elements (the PDSA cycle; a single narrative). Learning was conceptualised as distributed through space and through assemblages of objects; the students' acceptance of ambiguity and negotiating spaces created effects of learning and identity.

As discussed in earlier chapters, knowledge is commonly considered as acquisitional, and learning as a property, attribute, something that can grow, or increase in size. This is partly because of the language used and the biological and psychological models that have been associated with education for so long. The problem with this is that it restricts what can be done as educationalists. Conceptualising learning as a network effect helps to build an alternative language in medical education. The concept of multiple worlds extends this to challenge the conditions of possibility. If we follow a scientific path in research, we subscribe to an essentialist view. To extend this, we can say that our research views the object of our inquiry from different perspectives, to converge or 'triangulate'. ANT says the opposite. If we accept that, rather than perspectives of the same thing, we are studying different or multiple worlds, then the 'object of inquiry' becomes decentred; it becomes more than one and less than many. The physical space becomes different worlds that are enacted in different ways. It is either opened out or sectioned off. What pulls the world together are the practices that become unique to that

space. What opens it up are the nomads that move across the floor at different timescales and the unlocked doors.

## Chapter 9: Reconceptualising Learning through ANT

## **9.1 Contribution of the research**

This research has contributed to the field in two ways: firstly, in the development of ANT as an empirical methodology, and secondly in the development of pedagogical approaches of improvement science in medical education. The methodology developed in this research demonstrates how ANT can be drawn from as a sensibility to interrupt research and to critically engage with medical education research. The thesis has developed the language of learning in space/time and as a relational concept, helping educators to realise that the conditions of possibility for pedagogies of improvement science can be challenged. In terms of medical and professional education, this research has contributed a detailed account of the mundane practices of SLISPs, and through description has offered critiques to the pedagogies of improvement science. Finally, this research has reconceptualised learning by moving away from traditional notions of learning as fixed and pre-existing, towards learning as fluid, dynamic and constantly reworked through networks, assemblages, and different worlds of practice.

Three anecdotes were used throughout the analysis (antimicrobial prescribing, insulin recording, and pedagogies of improvement science) and the ANT dimensions of analysis (networks, symmetry, and multiple worlds). The concept of networks allows the research to focus on relationality and emergence of effects rather than attributes of separate components, thereby de-centring the human to produce accounts that challenge conventional labelling, boundaries and privileging of important actors. The notion of symmetry allows learning to be conceptualised as assemblage, turning the relationality of the network towards the spatiality of collectives of humans and non-humans. Other concepts, such as multiple worlds, allow for alternative imaginings of learning as associations through multiple enactments (Sørensen 2009).

## **9.2 Five key points**

This research set out to ask: how is learning configured as students carry out the SLISPs on a hospital ward? And, how do the ANT concepts of networks, symmetry and multiple worlds, contribute to an understanding of professional and medical education?

In this section, five key points from the research are foregrounded to address these questions. The points are made separately, but there is much overlap and entanglements

with the other points. The key points should be considered as a way of organising and ordering the discussion by foregrounding insights that relate to the original research questions.

- The first key point draws out the notion of learning emerging from the potential disruption that occurs as networks collide.
- The second point focuses on how materials shape (or invite) practice and learning by how they are assembled and enacted.
- Point three highlights how the enactment of practices becomes visible through ‘*un-black-boxing*’, and how learning effects are produced through challenging singularities.
- Enactments of power through ontological politics are explored in the fourth point, to emphasise how learning comes about through regulating difference between different worlds of practice.
- Finally, the fifth point turns to the idea of human-as-assemblage, creating identities and reconceptualising professional learning.

### **1. Conceptualising networks: learning as disruption**

Through identifying and exploring actor-networks, the analysis drew attention to two things: (i) how writing about learning as a network effect rather than as an individual acquisition provides an alternative language to situate learning in space/time; and (ii) how learning can be conceptualised as an effect of the collision between new and existing networks of practice. Individualism, and the notion of the heroic individual, is prevalent in medical education (Bleakley 2012). This has partly emerged from how doctors are expected to behave, and through discourses such as the ‘character’ of a ‘good doctor’ (Whitehead et al. 2013). Calls for accountability, skills and competence further reinforce individualism and the requirement for personal ‘growth’. In this research, the idea of learning has been presented as collective and sociomaterial. This raises challenges to the language of learning in medical education by moving from the individual to the collective and articulating learning spatially and relationally. Learning relates to the discipline itself, and as Nespor (2014:11) suggests, to the movement of the student through this discipline:

‘Learning’ (in) a discipline isn’t a matter of transforming one’s psychological make-up ... Instead, ‘learning’ should refer to the changes in the spatial and temporal organization of the distributed actors/networks that we’re always part of ... Students enter into disciplinary practice when they begin to move along trajectories that keep them within the narrow range of space-times and distributions that constitute the discipline.

In this study, the students were considered to be part of the networks that produced learning; they were considered as being assemblages of human and non-human entities, connected to networks that valued different types of knowledge. The student could be said to be performed into being by the networks they are part of; as Latour asserts, ‘entities gain their identity only through other entities’ (Miettinen 1999:176). In this research, the student disciplines were medicine and pharmacy, but the notion of ‘improvement’ as a discipline through SLISPs was also introduced. The assemblages and distributions that characterise improvement methodologies are not the same as those that are enacted in medical and pharmaceutical practice. In addition, the clinical workplaces in which the students were leading projects are connected to well established networks of practice that define clinical work. This suggests that the students and the networks they are connected with are coming into contact with other networks through enacting the SLISPs. The question of student learning moves from: ‘what did the students learn?’ and becomes: ‘how do we enquire about learning from a network perspective?’ In the case of this research, learning emerges as human and non-human materials (students, forms, software, devices, processes and so on) assemble to create networks of improvement, existing practice, and professional disciplines. In addition to networks, an emphasis on symmetry, through assemblages of human and non-human actants and the relations between actants, provides another metaphor to describe learning as sociomaterial. The concept of learning as assemblage incorporates the social (e.g., negotiations around meaning and knowledge within groups) and the material (spaces, objects etc.). In this version, learning is relational, with the focus on:

*associations, or connections, or relations* through which matter and meaning, object and subject, co-emerge ... learning achieves its form



as a consequence of the relations in which it is located and enacted.  
(Mulcahy 2014:56)

The antibiotic story network and the sticker network presented ways of articulating learning as an effect produced beyond the individual and enmeshed in workplace practice. Another contribution of the network concept is that of stability, movement and strength: in classic-ANT, networks become stable when the performances that support them are repeated, and the forces that make connections are strengthened. Networks then become mobilised and form connections with other networks. An important consideration is that continuous work is required for this stability; networks can become destabilised or disrupted by performing practices from other networks, or through resistances or reform. All these considerations are relevant to improvement science and how this has become enacted in SLISPs.

The concept of networks allows for SLISPs to be reconceptualised, moving from a benevolent 'improvement' in patient care, towards a potentially disruptive intervention to everyday practice. This study has demonstrated that it is a fine balance between improving practices and disrupting work. However, if no improvements are made there is a risk that practices may lead to harm, such as inaccurate prescribing of antibiotics leading to kidney infection, or inaccurate prescribing of insulin leading to hypoglycaemia. To make a meaningful improvement the new practice needs to take hold, to build connections, and to be performed repeatedly, aligning and ordering materials to support this new practice. If this is not achieved, the improvement will not take root and the network will disintegrate. However, the value for the students is in the formation and breakage of connections, as the learning is in the potential for disruption: it might not make for consistency, but the students are able to attune to what matters for them and their SLISP (Fenwick 2014b) and to understand the complexities for implementing change. Allen (2013) demonstrated through research into the implementation of Integrated Care Pathways (ICP) that innovations and improvements can be disruptive to practices, creating new problems. For example, in Cohort 2 the sticker added more boxes for information relating to insulin. Even though there was staff support and evidence to support collecting additional information, this required a change in practice that was potentially disruptive.

For Cohort 1 improvement science was regarded as a ‘mindset’ with a weak connection to the IHI Practicum templates. The implication for Cohort 1 was that connections and associations had been made in practice over time and that new networks had formed, with the IHI network retreating and new ‘improvement’ networks stabilising or mutating (Fenwick and Edwards 2010). The new connections for Cohort 1 suggests learning emerged as effects from the changed configuration and organisation of the new networks. For Cohort 2, learning effects were distributed in the configuration of SLISP practices, for example, in the fishbone diagram. SLISPs provide a way of mobilising improvement science methodologies, alongside promoting the student as a leader and change agent (Paterson et al. 2011). This has implications for the role of the professional. Improvement science, as a healthcare improvement innovation, is enacted by internal and external networks (staff ‘buy-in’, SISCC, IHI Practicum and so on). This research does not claim to act as an evaluation for either SLISPs or improvement science (for an evaluation of improvement science in nurse education, see Armstrong et al. 2015), but provides an interruption to the assumptions and deletions that have already begun in relation to improvement science. This research argues that instead of establishing a ‘common language’ it is more useful to explore how improvement science is enacted in practice.

At the start of this study, it was recognised that SLISPs offer students a new way of learning that is situated in workplace practice. Current approaches to learning in healthcare (and many other areas) are focused on individual acquisition, for example measuring competencies, attributes, skills and attitude. A different approach to learning is required that can accommodate changing values in the NHS in the move towards interdisciplinarity and team work (Bleakley 2014), which brings different networks into contact, creating new networks and disrupting existing ones. ANT offers an alternative language for educators by describing learning as situated, distributed and enmeshed.

## **2. Materials inviting practice**

The focus of this section is the notion of objects ‘inviting’ practice. The choice of language draws from discussions on how an ANT sensibility influences terms and descriptions. For example, Abrahamsson et al. (2015) present the terms ‘affording, responding, caring and tinkering’ to replace more commonly used terms such as ‘causing’ and ‘acting’. Fenwick (Fenwick 2014b) suggests the use of the terms ‘attending,

attuning, noticing, tinkering and interrupting' specifically in relation to medical education. In this section, the term 'inviting' in relation to practice is included to encompass Latour's ideas of technical mediation (Latour 1999a) and Fenwick and Edwards' (2010) descriptions of the sociomaterial in education. There are examples in the literature of how materials invite or shape practice. Latour, writing as Johnson (Johnson 1988), describes how the door-closer 'programs' the human as they take passage through the door: the human is 'coded' to walk at a certain pace, to avoid either having to squeeze through a narrow space if they approach the door too soon, or having the door shut in their face to give them a bloody nose. This is an example of how materials influence behaviour, and describes the move away from the idea of human agency which is prevalent in the social sciences. Latour (1999a) describes relations in human and non-human collectives as shaping reality: objects and humans do not exist separately, but collectively and relation to one another. As has been demonstrated in this research, detailed descriptions of everyday practice are therefore necessary to attune to these relations and practices. Because of this, some authors argue that ANT accounts can be mundane and irrelevant (Collins and Yearly 1992). However, in the hospital, the students were required to negotiate corridors, stairs, the buzzer system, the bleep system, the locker room and clinical spaces; although time-consuming, these practices formed how the SLISPs were carried out and highlighted the importance of recording detail. In Cohort 1, locating paperwork on the wards, negotiating the space of the wards, and the manipulation of materials, were time-consuming and seemingly repetitive practices that might not have appeared significant in the practices of the SLISP. However, the performance of the student collecting information brought attention to how material assemblages came together and created effects (Fenwick and Edwards 2010).

The physical shapes of actants invited or excluded practice, for example, trolleys for transporting multiple ringbinders contrasted with cumbersome double clipboards that resisted being stacked and transported *en masse*. The materialities of each ward were unique and contingent, and could not have been replicated in a classroom or simulation. Although medical and pharmacy students are taught about dexterity relating to the clinical and medical aspects of their roles (Bleakley et al. 2011), it is difficult to justify teaching how to juggle paperwork, pens, stationary and so on, despite this being a crucial part of the job. The students became familiar with materiality by being present on the

wards during, for example, ward rounds, but the SLISPs enabled students to physically work with paperwork and to form connections with patient information.

In the third anecdote in Chapter 6, the example of the blank 'bone' in the fishbone diagram illustrates how a gap can pose an invitation to be filled (Sørensen 2009). Some of the effects of inviting practice were very powerful: for example, in Chapter 8, the first anecdote describes the yellow review sticker, which allowed nurses to challenge the authority of senior staff by using the sticker to prompt a review on the prescription chart. Other material properties, such as colour, were powerful actants on the ward. For example, the red bar across the gentamycin chart allowed it to stand out against the prescription chart and makes it less likely to misplace; the pink colour of forms relating to insulin use was copied for the sticker, to associate it with insulin prescribing procedures. In the example of the insulin sticker, forces and effects became evident through its enactment in the SLISP. The co-emergence of matter and meaning (Mulcahy 2014), through the increased power that the sticker was collecting through various enactments, was evident in the increased presence of the sticker on forms in the wards. The secret drawer demonstrated how the assemblage of entities influenced the SLISP and the performance of the sticker in relation to the 'improvement'. In another example, the locker presented how assemblages of human and non-human entities come together to shape practice. The online practices in Cohort 2 was another example of how the SLISP was driven through material configurations that subscribed to electronic media. An early commitment to electronic templates created greater forces through online forums and closed media sharing repositories. The location and use of the locker, the distribution of materials across floors and the distribution of the students, commuting via trains and buses, all contributed to how the SLISP was enacted.

In both SLISPs, spaces were occupied for practices they were not explicitly invited to undertake or spaces designated for specific activities were not conducive to those practices. For Cohort 2, the locker room performed many spaces, including the project work, meetings/handovers, and storage both inside and outside the actual locker. There was one small bench in the locker room, but no other furniture, so when the students used the space for sticking on stickers other objects were used as furniture: an umbrella, an iPad, a lap, the floor. Although teaching rooms were designed for the purpose of student working, there were booking systems that sometimes prevented these from being enacted

as learning spaces for the SLISP. The access (buzzer) system for the pharmacy offices prevented use as a learning or meeting place. The buzzer system was identified in ANT terms as an Obligatory Passage Point (OPP) in the analysis. Identifying OPPs are useful for understanding where the bottle-necks occur in practices, and what can slow practices down.

The examples in this section highlight how materials can drive and shape practice, and how SLISPs need to be attuned to the sociomaterial practices of workplace learning. Attuning to these invitations helps the researcher to notice how learning emerges from assembling and ordering both human and non-human entities, and how this results in patterns of practice that are not purely consciously controlled by humans. This addresses some of the critiques of ANT and highlights how ANT differs from other sociomaterial approaches such as complexity theory and CHAT.

### **3. Invisible, black-boxed practices**

There are a number of ways in which practices might become invisible that relate to the three ANT dimensions foregrounded in this analysis. First, the notion of networks and focus on relations between actors might foreground more powerful actors and bracket others: this highlights the importance of analysing networks by recognising less prominent actants, and to focus instead on effects and relations. Inscription devices, systems that translate knowledge from one form to another, can also be identified within networks to identify minute points of translation that might otherwise be hidden (Latour and Woolgar 2013). Second, the work involved in sustaining mundane practices sometimes leads to practices being taken for granted or black-boxed: a symmetrical approach provides a way of attending to the everyday detail and making processes visible again. Thirdly, conceptualising the multiple from a singularity also opens out the complexity of practice. This can be achieved by seeing ‘matters of fact’ as ‘matters of concern’ (Latour 2005). Praxiography (Mol 2002) is an empirical approach to holding open controversies and conceptualising multiple worlds. From Mol (2002), Law’s descriptions of regulating difference provide examples of how different worlds can exist together, or how one world can dominate through ontological politics (Law 2004b).

Throughout the research there were examples of how practices were taken for granted or ‘black-boxed’. The SLISPs provided a way of prising open the black boxes, by

approaching the familiar as strange; for example, the pharmacy students from Cohort 2 voiced their surprise when encountering practices on the ward, and the tour of the surgical 'floor' re-presented the separate surgical wards. In the example of the sticker, the configuration of the pharmacy offices and materiality of the buzzer system to gain entry, all conspired to influence the way in which the SLISP was carried out. However, in everyday practice, the bleep and buzzer systems may not be considered important, as these have been mastered by experienced staff. These practices become deleted, much like the magic trick of sawing the woman in two (Chapter 7): the woman in the box hides her contortions, creating the illusion that the saw is going through the middle of her body. The deletions that make magic tricks possible, i.e., assumptions of what is capable of acting (in the case of humanism and sociocultural approaches, humans are the only agents) enable practices to become invisible and deleted. There are other ways in which some things become invisible: attending to what is considered important and made present, results in absences. And, as Latour (1999a) noted, by ascribing purposeful action and intention to humans, the contribution of objects in processes can go unnoticed. Criticisms aimed at early-ANT conceptualisations of networks were that they foregrounded the most powerful actors (Fenwick and Edwards 2010; McLean and Hassard 2004), and overlooked others. This illustrates how networks can also make some practices invisible because of *a priori* assumptions about what is important. This is particularly significant when researching workplace and professional education, where everyday detail contributes to practice and learning in myriad different ways. The implications of error in clinical working are considerable. The example of the sticky strip on the gentamycin form is an illustration of this: stationery might not be considered important compared to medicines, but when a gentamycin form is lost, the patient is a risk of receiving a harmful double dose, leading to kidney infection. Similarly, the lack of information relating to insulin prescribing on the medical reconciliation form might lead to hypoglycaemia.

The process of bracketing practices through inscription devices is explored by Latour and Woolgar (2013). These devices are configurations of materials that transform material into text, such as a blood test to prescribe the correct dose of gentamycin. These systems delete practices until all that is left is the result or process which defines the limits of practice. In Latour and Woolgar's (2013) exploration, the focus is the construction of scientific papers through laboratory practices, but there are analogies to working practices

on the hospital ward. Latour's (2005) notion of 'matters of fact and matters of concern' refer to a premature unification of things that are closed down into a singularity. Improvement science might be an example of this, where the complexities, disputes and controversies are either glossed over or bracketed. 'Matters of concern' come about when complexity is allowed to open out. In this research, the buzzer system has been collapsed into a singularity of practice, but the observations allowed the assemblage of associated practices such as waiting, the door, the clinical lead, to be explored in detail. The challenge with this approach is knowing when to stop: Latour (2005) describes this using Zeno's paradoxes, where the continual process of unfolding slows everything down to an absurd rate.

It is commonplace and necessary to delete the work and effort that goes into practices as a way of ordering work and producing procedures and protocols. However, SLISPs enable other things to become present and absent, to question the limits of possibility. For example, the buzzer system for the pharmacy offices was not included in the induction presentation for Cohort 2, neither was the process of making the stickers or booking teaching rooms. However, these were the working practices that shaped Cohort 2's SLISP. The implications of this are that much of the work of the SLISP becomes invisible when the IHI Practicum report is produced, even though this deleted work may be of value to future projects. Instead, the templates (PDSA forms, run charts and so on) act as the mouthpiece for SLISP activity. The enactment of improvement science as a healthcare innovation can be understood differently with an ANT lens. This research has articulated a way in which hidden work can be made visible. The example of duration in Chapter 8 focuses on multiplicity and multiple ontologies (Mol 2002), drawing out the different ways in which multiple worlds can be conceptualised as either layered, drawn together, converted, rationalised or dominant. Law's (2004b) interpretation of 'regulating difference', following Mol's (2002) praxiography, demonstrates how the different recordings of duration were held together in practice through translations, where information is converted for different practices, and how the supervisor meeting rationalised duration, explaining away difference through dialogue.

In this study, improvement science could be considered as an example of an intervention that has been packaged and transported as an immutable mobile to different settings, with an expectation of consistent results. Immutable mobiles, described in Chapter 3, page

48, can be defined as stable actants which hold their shape of relations so that they can be transported without changing. However, as has been demonstrated in the literature around the WHO surgical safety checklist, mobilisation brings with it translation, which is ultimately treason and betrayal (Law 2006). In other words, if an entity is expected to perform in exactly the same way in a different context, then this can lead to unexpected effects as new associations reconstruct the entity in a different way. Studies on new innovations that are packaged and measured as a consistent ‘thing’ are therefore problematic, as the ‘thing’ shifts and mutates according to the networks it becomes associated with. This study confronts the shifting, mutating mass as a dynamic process of relations, associations and connections that can be noticed when attuning to workplace practices – not just through the behaviour and actions of humans, but in the chains of translations in heterogeneous assemblages of human and non-human entities. There is a risk that approaches such as improvement science become automatised uncritically (Law 2004b), leading to the assumption that it will have the same effects in different circumstances. This research has presented improvement science as a way of *un-black-boxing* activities and processes to explore invisible practices that might otherwise be overlooked.

#### **4. Ontological politics of learning: regulating difference**

The previous points begin to explore issues of power through the lens of ANT. As Fenwick and Nimmo (2015:78) point out:

sociomaterial perspectives offer important approaches for understanding the power relations and politics that constitute learning. Their analytical tools can interrupt and trace the ways powerful webs become assembled as knowledge, but also point to affirmative ways to intervene in, disturb or amplify these.

The concept of powerful discourses, particularly those of selling and resistance, has also been explored in this study. However, it has been argued that hegemonic discourses are derived from human-centred traditions and, as such, focus on the social more than the material (Fenwick et al. 2011). In this research, the discourses of selling and resistance were identified as network effects (sometimes resistance, sometimes alliance). This is an



important consideration as there is a risk that discourses are privileged above other, more material effects, such as the configuration of paperwork and stationery.

The concept of multiple worlds in Chapter 8 enabled several issues to be drawn out in relation to learning. First, ambivalence and difference were pursued in the data: ANT looks down into the data, into the baroque curlicues of the detail of practice, finding openings through ambiguity (Law 2004a). Second, the idea of multiplicity is presented: not of multiple perspectives, views and subjectivities of the same 'object', and not of fracturing a singular object into multiple pieces, but something in-between: more than one and less than many (Law 2004b). With the example of duration, the seemingly singular recording unfolds into multiple practices of medicinal prescribing, monitoring and administering; but rather than fracturing 'duration', the practices function together. This brings a third notion of multiple worlds: the practices of duration exist in different worlds, which function side by side. These worlds are performed into being and shaped by practice. Fourth, where worlds exist side by side, some might become dominant and others are lashed together through rationalisation or narrative. These 'regulating differences' are acts of ontological politics (Mol 1998), the decisions that are made to shape a world, coming from priorities, authority and professional judgement. In healthcare, the idea of a 'common language' is a way of rationalising difference in an attempt to smooth out inconsistencies and to produce an unchangeable entity that can be transported without change: in ANT terms, an immutable mobile.

The distribution of power and authority was explored through the recording of 'duration'. The tensions and strain (Fenwick and Edwards 2010) that were created through ambiguous recordings of duration signposted to different worlds of practice. The record for 'duration' became a multiplicity with relations in multiple worlds. The enactments of practices around duration connected to different worlds for different roles: the nurse is connected to the administration of medication and the medication trolley; the junior doctor relates practice to medical training, protocols, decisions made by the registrar, patient test readings and so on. These associations could be noticed in the 'remove background' pictures (Figures 7.2 and 7.3). For Chris, duration became a balance between clinical judgement and protocol, resulting in ambiguity in the records. Authority and power arose in the negotiations that took place in recording duration, as practices highlighted minute translations which deviated from protocol with the purpose of

exercising clinical judgement. The duration example draws from Mol's (2002) multiple worlds to demonstrate how practices and roles enact duration from the same prescription form. The power of the prevalent world can suppress other versions and set the conditions of possibility. Star (1990) quotes Everett Hughes' 'it might have been otherwise' to describe how some versions are suppressed through history and how some prevail, such as the red colour of a traffic light signalling 'stop'; the red colour was a choice, not an innate symbolism of the colour red to prompt stopping. In a similar way, insulin recording forms for Cohort 2 were associated with the colour pink. The current version, the 'way we do things', might not be the only way; existing practices might 'improve' with the introduction of a SLISP, but the change itself is disruptive. Improvement science methodology addresses this through 'balancing measures' to anticipate 'unintended consequences' but this could be construed as an oversimplification of complex social practices.

The anecdote of Cohort 2's project, through the IHI Practicum, enacts improvement science as rapid change; however, Cohort 1's SLISP demonstrates how improvement science is employed to implement change over a longer period of time. In terms of 'what is at stake' with these two versions, rapid change might sacrifice detail, and longer change might sacrifice responsiveness and timeliness. It is beyond the scope of this study to argue in favour of either version, as might be the case in an evaluation. Rather, this study highlights the ontological politics that take place in the enactment of improvement science and what the implications of this are on learning. In the case of Cohort 2, learning emerges through practices of the IHI Practicum and the electronic format of the SLISP report; different worlds may have been created through manual approaches that may have produced different learning effects. For Cohort 1, learning was enmeshed in the practices of antibiotic prescribing, with improvement science as a mindset being introduced to these practices. Again, different worlds may have been created through a more rigid application of IHI templates: a 'network of prescription' rather than a 'network of negotiation' (Fenwick and Edwards, 2010) with different learning emerging as a result.

## **5. Assembling realities**

During the fieldwork and analysis, the concept of professionalism and membership emerged in the assemblages of materials that signified a nurse, doctor, patient and so on. For example, the uniforms, lanyards, and comportment of bodies identified the

ambulating blue-clothed body as ‘nurse’, while the prone body in a bed with plastic tubes and IV stands as ‘patient’. Throughout the fieldwork and analysis, the patient became recognised as a manifest absence (Law 2004b). The embodied patient may have been absent, but the patients themselves were present in other ways: distributed through paperwork, in different parts of the ward. Mol (2002) describes the ‘fleshiness’ of the patient body, its different ‘layers’ and that a body may be multiple without being plural. Star (1990) has also highlighted the notion of multiple membership, and how a self can be distributed through different networks. The antibiotic story of the patient was connected in different places to different networks. The work of the SLISP was to make new connections and associations, but in so doing, the information went through points of translation. This process highlighted the contingent nature of information, for example, recording patient notes (Berg and Goorman 1999), and how new networks began to form alongside existing practices. The meaning of the antibiotic story was a new reality, a new set of associations and assemblages, rather than a representation of the patient. The antibiotic story crafted the patient and performed their reality into being. For Chris, the antibiotic story was about associating and connecting in new ways, resulting in learning effects. The concept of networks worked well in conceptualising the SLISP as a new network, and how overlapping connections sought to disrupt and rupture (Fenwick and Edwards 2010) existing practices to introduce the ‘improvement’. From the anecdotes in this study and other ethnographies, there is an argument against the potential amorality perceived in de-centring the human (Pels 1996). In this study, the human is present in ANT accounts, but in a range of manifestations that challenge embodiment as a singularity and present the patient as dispersed.

Other assemblages were explored in the research, relating to the different professions of hospital staff. It became clear that the differences between roles were more complex than simply the allocation of practices. Staff rotation (junior doctors), shift working, being located in one ward (nurses, doctors) at a time or several at the same time (pharmacists) created effects on practices and spaces. The SLISP introduced a new set of practices to the students which cut across some of the boundaries created by roles. There was an emphasis, from the student supervisors, on interdisciplinary working. This was aimed towards clinical teams and professional learning, and in Cohort 2, the interdisciplinary aspect extended to the students themselves. The implications of interdisciplinary working are that there are networks colliding and destabilizing to accommodate different

ways of working. An observation from the study is the way that a single object (such as a clipboard or the prescription chart) can signpost different worlds of practice. The handling of materials signposted to diverse practices: the student was recording information for the purposes of improvement, whereas the nurse was checking information to treat a patient. The prescription chart was an interesting example of how objects connected with practice. In my study, nurses referred to the prescription chart as a 'Kardex' or 'X-PAR'. These descriptions explicitly include the administration role (X-PAR stands for X-Health board; Prescription and Administration Record). Pharmacists use the term 'prescription chart', a term which black-boxes administration and recording. The medical students usually referred to the X-PAR, but sometimes used the other terms. In the example of recording 'duration', the different practices of prescribing, administering and reviewing duration were all under the same label. The significance of this is how practices perform a label into being; repeated performance strengthens the identity of that practice. In different disciplines, the same referent performs differently. The SLISP became a way of performing improvement science; the twin purposes of 'students as change agents' and rapid improvement are strongly connected in a network of practices that includes the IHI Practicum and the endorsement of senior clinical staff. However, it is likely that there is much diversity under this banner that will be unrecognised from the deletion of practices to reduce activities to a SLISP.

The interdisciplinary aspect of the SLISPs was emphasised and encouraged, particularly in Cohort 2. There is a shift towards interdisciplinary practices in healthcare (Ahn et al. 2015; Bleakley et al. 2011) that has implications for working practices. This study has highlighted how networks are formed through practices of different disciplines, and also the potential disruption change can have in destabilising these networks. Repeated enactments cause practices to be deleted, shaping the world of the discipline through ontological politics. The difference between worlds can mean that some ideas are alien or even absurd: the way that the clinical space of the surgical floor is conceptualised challenges the confines of the ward; working patterns create different practices such as the 'secret drawer'; recording duration produces ambiguities that have different implications in different practices. The SLISP, as a new network forming, illuminates some of these absurdities and presses for change and 'improvement'; counter-forces preserve practices with the logic of the discipline. The implications are that 'improvement' is not a consistent change that will have the same effects on different

networks of practice, but will be enacted differently in different worlds. For the students, working towards inter-disciplinarity creates destabilising effects but can challenge the conditions of possibility in working practices. An effect of these intersecting worlds is that learning is reconceptualised as collective, situated and contingent in practice.

### **9.3 Educational implications**

Traditionally, learning is measured as an individual attribute that has accumulated because of increased knowledge. This study moves away from such assumptions, to conceptualise learning and knowledge as effects in space/time (Nespor 2014) and as dispersed (Mol 2002; Sørensen 2009). Rather than saying: ‘this is what the students learned whilst doing the SLISPs’, we could say that they have become part of new networks, performed connections and relations to networks, become part of an assemblage of human and non-human actants that enact improvement science, and have become attuned to the different worlds that hang together under the banner of patient care. Therefore, learning, as an effect of the SLISP network, is manifest in the repeated negotiations of clinical space, the reconceptualization of spaces and the acceptance of different worlds that hang together to create reality: practice precedes reality, and the enactment of improvement science has created multiple realities. The question changes from: how effective is improvement science or SLISPs in terms of student learning? to: what reality has gained more ground and what political decisions got us there? The focus of this research was on professional learning. Interdisciplinary-working, team-working and co-production are all considerations of professional learning, and these aspects have been investigated as part of sociomaterial practices in medical education (Bleakley et al. 2011; McMurtry et al. 2016) and other areas of professional education (Fenwick and Nerland 2014). The implications of this research are to further press for sociomaterial conceptualisations of professional learning, with the purpose of gaining a different understanding of how practices in the workplace are enacted and how learning is situated and contingent rather than individual and psychologised.

The implications were that learning was conceptualised through connections, rather than a linear progression from what is unknown to known, culminating in accumulated learning. The connections themselves were enacted through practices whilst carrying out the SLISP. In this study, symmetry provided a way of observing practice as relational.

Treating human and non-human elements of the network equally can lead to noticing details of practice, significant to learning, which might otherwise be overlooked. In the case of this study, symmetry allowed for noticing how materials such as ringbinders and clipboards invited or excluded practice, shaping the activities for the student carrying out the SLISP. Learning is conceptualised as situated and dispersed through heterogeneous assemblages of human and non-human entities such as the gentamycin form, ringbinders, paperwork and clinical spaces. Finally, instead of collapsing improvement science into a 'common language', multiple worlds allowed for different enactments of improvement science to co-exist, to challenge the conditions of possibility. In the analytic example, the recording of duration was identified as an ambiguity that pointed to diverse practices on the ward that 'hung together' (Mol 2002) around the same document (the prescription chart). For Chris, learning was contingent in the meanings suspended between worlds, rather than in the reconciliation of diverse practices into a singularity.

### **ANT as methodology**

This research was considered to be a timely interruption to the improvement science literature. Other innovations might also benefit from the form of detailed analysis ANT has to offer. For example, the World Health Organisation (WHO) Surgical Safety Checklist (SSC) was introduced as a healthcare improvement in 2008. The research conducted on the SSC has been largely quantitative which has led to the proliferation of replication studies, producing varying results. A study of the SSC literature concluded that, rather than knowledge becoming mobilised to inform policy decisions, the evidence has come to a standstill (Mitchell et al. 2017). An open letter to *The BMJ* conveyed the strength of feeling in the medical community about the need to draw from more qualitative studies in order to make meaningful decisions (Greenhalgh et al. 2016). In this case, ANT could provide a robust and complementary research methodology. In evidence-based healthcare interventions (such as the surgical safety checklist and improvement science), there is sometimes a tendency to homogenise the intervention to allow for evaluation and measurement. However, this research argues that matter and meaning emerge as a result of different associations in different worlds, and that these should be more closely scrutinised alongside evaluation. In addition, as healthcare moves towards interdisciplinary-working and team-working, individualised learning approaches relating to competencies, skills and attributes need to be superseded by more collective,

sociomaterial readings of learning. ANT also provides a way of challenging categories and boundaries by identifying assemblages that are associated through practices.

This research has brought to light the physicality of enacting SLISPs, through manipulating forms and stationery, electronic hardware and software, negotiating corridors, stairs and doors and taken-for-granted procedures such as the buzzer system. It has shown how the learning effects of the SLISPs bring new aspects to the professional role of the students, such as interrupting, disrupting and challenging existing practices as part of clinical work. This raises the question of what is at stake as students take on the role of improver and leader as well as clinician: the professional role might be viewed as more interdisciplinary, and what might be at stake is specialism and expertise. More broadly, this research explored how innovation and change can be introduced to existing practices and the effects these have, particularly the learning effects. The concept of networks is helpful in conceptualising the strength of existing networks to sustain everyday practice, and how resistances to change can make it difficult to implement improvements. Multiple worlds highlighted how multiple practices exist alongside each other but might not be commensurate with each other. In this scenario, as demonstrated through the recording of 'duration', 'improvement' may be greater in some areas than others. Indeed, this is what Allen (2013) found when investigating Integrated Care Pathways; the codified format suited some practitioners, but the nuances and variation in other practices were not easily integrated into the new way of recording.

### **ANT and medical education**

There has been a growing interest in sociomateriality in researching medical education (Fenwick and Nimmo 2015; McMurtry et al. 2016). This research has led to a more detailed knowledge of improvement science practices *in situ*; medical educators are better informed of practices undertaken by students during SLISPs. Pedagogies of improvement science include classroom lectures, eLearning (through the IHI Open School Practicum), supervision guidance, and workplace learning. This research has described how these assemble and the importance of situated learning in the workplace. The research also addresses the appropriateness of different pedagogical approaches and the implications of these. There is a degree of incommensurability and disruption which contributes to the learning process. Different meanings reside in different worlds, and this is difficult to measure or articulate. Improvement science becomes a synecdoche

(where a part represents the whole) of the SLISP, with one part describing the whole process and deleting other parts. Along with multiple worlds is the acceptance that entities exist only alongside other entities, so improvement science becomes associated with different entities in different worlds. This challenges the idea of a 'common language' as terms take on different meanings in different worlds.

Learning has been explored throughout the thesis. The pedagogical approach for learning improvement science was to create student-led projects in workplace settings to allow students to work unsupervised and to make decisions relating to the improvement. What the research has demonstrated in relation to this, is that the workplace setting is crucial in order to appreciate networks of existing practices; although simulation is becoming a popular pedagogic approach in medical education and pharmacy (Bleakley 2014; Buchan et al. 2014), improvement is an area where workplace practice is beneficial. However, as the analysis suggests, improvement requires an engagement with, and a disruption to, existing networks of practice. The students undertook eLearning modules through the IHI Practicum prior to starting their projects, and Cohort 2 received some classroom-based instruction and guidance before entering the wards and on their first visit. These activities created the effects of power as students came onto the wards to collect information and canvass staff about their improvement projects. As the SLISPs were enacted, connections and associations formed a network which interacted with existing networks of practice on the wards.

Interdisciplinary working is becoming more widely promoted in the NHS as a way of working (Bleakley 2012; Bleakley 2014; Falk et al. 2017; Fenwick 2014a; McMurtry et al. 2016). It has been argued that the learning that accompanies these ways of working needs to be consistent with shared working procedures rather than individualised competencies and skills (Bleakley 2014). It is challenging to move away from individual attributes in the context of exams and personal achievements; the language of learning is also embroiled in individualism, with terms such as 'skills' still prevalent in the current improvement science literature (Gabbay et al. 2014; Lucas and Nacer 2015). The social perspective, as introduced by Mulcahy's (2014) three tales of learning, introduces an alternative to cognitive, psychologised approaches to learning by discussing learning as part of a collective and situated in practice. The sociomaterial perspective extends this to include assemblages of humans and non-humans that form relations and practices, with



learning as an effect emerging from these interactions. In this research, learning has been described from the concept of networks as an effect of connections, and from the symmetry perspective as the ordering and assembling of human and non-human entities. Learning is also described as contingent meanings in multiple worlds that co-exist in practices. De-centring the human allows for descriptions of learning in the workplace that bypass the predilection for exploring motivations and intention, social structures and human agency. In terms of professional learning, this research has connected practice and learning and moved away from conceptualising learning as cognitive and acquisitional. This expands the lexicon for learning, and allows for social and material imaginings of workplace learning.

#### **9.4 Conclusion**

This study investigated learning as sociomaterial, drawing from ANT to conceptualise learning as a network effect. The pedagogies of improvement science took the student away from the classroom and individual examinations, and into the world of live practice, interdisciplinary work, teamwork and all the complexity that goes with this. Interconnections and associations were described through observing practice and then ‘following the actor’ as an entry point to the data. The three ANT concepts contribute to medical education in the following ways: first, networks can help educators conceptualise learning as dynamic, contingent and complex; pedagogies of improvement science can be adapted to help students appreciate the mess without attempting to capture the whole. Second, symmetry can help students and educators to see what would otherwise be overlooked: by challenging the assumption that humans are the sole source of agency, the human is decentred and more relational conceptualisations can be accessed. Finally, accepting the existence of multiple worlds that co-exist without pulling everything, including improvement science, into a singularity, can help educators to appreciate multiplicities without having to reduce them. The implications for medical education are to encourage pedagogical approaches that allow for relational learning in the workplace through inter- and intra-disciplinary learning; approaches that allow for learning as situated in assemblages of human and non-human actor-networks; and approaches that allow for interruption and ambiguity by allowing learning to unfold during practice. As well as providing insights for improvement science practices in the NHS in Scotland, this

research challenges the conditions of possibility for how innovations are enacted in the workplace.





## Chapter 10: Reflections and Recommendations

This research has contributed to the development of ANT as a methodology, specifically in terms of networks, symmetry, and multiple worlds. This chapter reflects on the ANT methodology that was developed and describes what could be done differently for future studies.

## **10.1 ANT and SLISPs**

The Scottish Improvement Science Collaborating Centre (SISCC), King's Improvement Science and the Health Foundation are attempting to consolidate recent implementations and to bring standardisation across the field. Student-led improvement science projects are only one facet of the approach, and this research has explored how SLISPs enact improvement science. In this research, it was not possible to disentangle the 'improvement science' aspects of the project from the 'student-led' aspects. Medical and pharmacy students are currently allowed to lead projects that are not necessarily related to improvement (such as audit), and can also participate in teams to contribute to improvement projects. This research can be used to gain insights into each of these. It was also sometimes difficult to disentangle the scientific method of improvement science and my own research; for example, sometimes I became involved in describing the subject of students' project through the ANT dimensions, such as prescribing processes, rather than the process of the student undertaking the SLISP. Carrying out two case studies helped greatly with this, as this enabled me to concentrate on what I was researching rather than what the students were researching.

### **Networks as an analysis tool**

To critique my analysis using networks, I return to the four problems with networks I described in Chapter 3: networks can be conveyed as fixed; the researcher cannot perceive the network as an 'insider'; network analysis has a tendency to represent only the most prominent actors; and there is a temptation to collapse everything into the network and not to exclude things which are not part of the network.

#### *Dynamic networks*

The types of networks I have been analysing are not physical networks of things with lines of connection in between. The earlier diagrams that helped me depict an actor (Figures 6.2 and 6.3) did not accurately portray what I meant by a network, so this could

be misleading for the reader. The diagrams portray a traditional, fixed, view of a network, rather than the dynamic networks I was trying to present. This is a dilemma similar to the one Nespor (2014) described when attempting to maintain movement in the data. I came to realise, throughout my analysis, that movement and dynamism were difficult to record and present in text and pictures, so I experimented with using images in different ways, such as the photomontages.

### *Describing networks as a researcher*

My role as a researcher changed throughout the fieldwork as I became more familiar with the hospital environment and more comfortable around the students and staff. It was never my intention (and would have been incongruent with my ontological position) to attempt to be impartial or detached. I had to acknowledge that I would affect situations, and to be sensitive to the workplace environment and the needs of the students. In terms of sensitising to networks, I was not an outsider looking in, but neither was I a full participant. My changing position also impacted the effects I had on the networks I was studying, and I have tried to acknowledge this throughout the analysis by recording reflective notes. I wrote the following poem to describe my role as a researcher:

#### **I am a Method Assemblage**

I've joined the students for coffee and lunch;  
done some home baking, brought in mince pies;  
offered an ear, been asked my opinion;  
tried to placate;  
smiled and nodded, sympathised;  
sometimes succeeded, sometimes failed not to get involved;  
helped out and had a go;  
accepted a lift and the loan of a bus fare;  
held the books, collected things;  
kept my nose out, stuck my oar in;  
sat on the fence, went out on a limb;  
been reflexive, reflective, pragmatic, biased;  
been off the boil and on the ball;  
I've been present, manifestly absent and hidden all at once.

During the fieldwork, it was difficult to attend to relations and connections as these were only visible through effects: looking at ‘things’ themselves did not always show how they related and came together. For example, during an observation I noticed a nurse going to a set of filing cabinets in a corridor on the ward. She looked in one of the drawers and found that they had run out of that type of form, and so then started a set of practices to go and get some more forms. If the forms had been there, the nurse would have engaged in a different set of practices (continuing with her work). So the absence of the form was agentic in that particular situation. Had I not been there at that particular time, I would not have noticed the role of the filing cabinets. The filing cabinets and the forms within the drawers were performing work that had become invisible.

Fieldnotes, 5th October 2015: Book 1, page 18:

A nurse goes over to the filing drawers where forms are kept, complains that someone has gone off with the last one of a particular type so she has to restock.

#### *Not just the ‘big’ actors*

The analysis process I undertook was not systematic, as would be expected in other approaches. The advantages of being systematic are that a representative sample and the resulting analysis outputs can be generalised. The analysis I undertook was iterative, in that I looked at the detail of what I had recorded, but I was also able to consider the range of what I had collected. I achieved this by keeping hyperlinked records to each stage in the fieldwork and summaries with timelines. I also created annotated collages of each cohort to give me a sense of each SLISP. Although I had to be selective in what I focused on, I was able to keep stock of the breadth of what I had collected. In this way I think I was able to acknowledge the detail of practice amongst the prominent actors.

Observing Cohort 2 and the sticker it became evident that learning was not confined to the individual student, and it was critical to have a theoretical sensitivity that allowed me to notice learning as a sociomaterial practice. The assemblage of materials changed over the month that I was with the students, influenced by both time and space. For example, there were time pressures for obtaining and making the sticker accessible. Buses and trains, the geographical distance of the two pharmacy students, the turnaround of staff on



the ward and differing practices on the night shift all had an effect on when the stickers were needed. The location of equipment (the guillotine, printer, sticker paper) and the pharmacy offices, and access via buzzer system, shaped the SLISP as much as the forms and meetings. At the start of the project, the students were not attuned to the wards and the footfall of admissions (except perhaps Lee, who had more experience, but could not have anticipated the low numbers of insulin-dependent patients; neither did the clinical lead). Because it was found that there was a small number of insulin-dependent patients on both wards during the time that the students were there for their project, that seemed to make it more important to ‘catch’ patients who were admitted during the night, and to perform activities such as ‘simulated patient’. Over the space of the month, the clinicians on the ward began to become familiar with the sticker and seeing it on the medical reconciliation part of the form. In this example, knowledge is generated through assemblages coming together. For example, the colour pink was a signifier of medical forms relating to insulin, and the pink sticker became associated with other insulin paperwork.

There were other cases where I felt the network approach would not be appropriate. For example, one of the interviews was quite intense and left a lot of unanswered questions. ANT was not the right approach to draw out nuanced meanings. There was a lot of non-verbal communication in this interview that would be more suited to conversation analysis or psychologised approaches. In contrast, the interview with Mac was very practical and detailed, which proved useful for understanding existing networks, but it was difficult to get a sense of the specificities I needed for the SLISPs networks. Both interviews were still valuable to my research, but in different ways.

#### *How to ‘cut the network’*

The focus of my research was the SLISP, and I was interested in the associated networks; however, it was not always easy to disentangle the SLISP from other networks. The students from Cohort 2 (and the medical student who was interviewed but was not part of a cohort) completed the IHI Practicum templates such as PDSA cycles, run charts, process diagrams and fishbone (cause and effect) diagram, so it was straightforward to include these visible artefacts as part of the SLISP. Chris was undertaking a long-term project, still drawing from the same improvement science methodologies, but not adhering to the same IHI templates and format. Chris described the IHI forms as a

'mindset' rather than something to adhere rigidly to; it was therefore not possible for me to identify parts of the SLISP in Cohort 1 from the paperwork. Chris's improvement work was also linked to activities in specialist groups and to existing knowledge of medical practices. In ANT terms, it could be said that there were existing networks relating to antibiotic prescription improvement and that Chris's activities reinforced some of these. Attuning to the SLISP networks was a challenging task, so I drew from the idea of using the gentamycin form as an actor to follow through my fieldnotes. This allowed me to identify points of translation, and forces and effects. Through observations and interviews, the SLISP gentamycin network emerged as part of other, overlapping networks. These included the gentamycin prescribing network, antimicrobial networks and other prescribing and recording networks. The forces within the SLISP included Charlie and the antimicrobial prescribing groups. It was difficult, as a researcher, to know where to 'cut the network'. For example, I could have included government HEAT targets relating to Hospital Acquired Infections, the antimicrobial stewardship MOOC and antimicrobial resistance agendas, as these created forces and tensions. However, these appeared to be distant and also connected with other, closer networks in several places. It seemed more appropriate to focus on Charlie as a more proximate force in Chris's SLISP network. As I became aware of the strength of connections, it became clearer where to cut the network.

It was difficult not to pull everything I observed into the networks I conceptualised. In a way, everything appeared to be connected. To counteract this, I attended to the effects and forces in the networks; if forces and effects were weak, this could signal where to cut the network. However, I had to judge whether the effect was weak or whether there was something I had not observed or encountered in an interview. I did not look at inequalities or gender issues in my study as this was not my focus. I also did not look at the wider medical student community, even though this might have been useful for understanding wider educational issues. There were some instances where I would have liked to have explored this further, but I had to 'cut the network'; I constantly referred back to research questions to help me do this. I did not include patients in my research. The students did not either, although some checking was done with patients along the way. Mostly the students were looking at forms and how they had been filled in. They recorded information from the forms onto their own data collection forms. The numbers represented patient readings, but not the patients themselves.

## **Researching symmetry**

My research addressed symmetry directly using observation and visual analysis. Although there were interviews with humans, the purpose was to draw out unseen connections, forces and associations. Adams and Thompson's (2016) set of heuristics for posthuman inquiry in their book *Research in a Posthuman World: Interviews with digital objects*, which address many of the critiques aimed at ANT and symmetry. The key points made in the last chapter align with these heuristics, which is encouraging in the sense of ANT as an enduring and cohesive approach. The following points first mention the heuristic and go on to describe how these resonated with my study.

The first four points relate to attending to things. *Gathering anecdotes*: I referred to stories in my methodology that ran through my data and developed these through description to construct three, robust anecdotes. These started out as smaller stories assembled after the data were collected. Some stories fell short of an anecdote because of fewer connections and strength than other stories. For example, I described the story of the guillotine in detail as part of the sticker network, but the description did not carry as far as I thought it would. I therefore made this part of the sticker anecdote. *Following the actors*: To begin analysis, my first strategy was to identify actors. As discussed earlier in this chapter, I needed to ensure that I was not privileging big, or important, actors as their presence would induce the absence of other actors. As described with the guillotine, some actors had more connections with networks than others, but to notice this, I had to follow them. *Listening for the invitational quality of things*: my second key point is about materials inviting (and excluding) practice. The interviews were helpful for understanding some of the less noticeable connections, and there were some surprises with incidents during observations. There were two examples of note: the invisible drawer and the secret drawer. Both highlighted how materials shape practice, and both were enacted as taken-for-granted practices which may have been overlooked. *Studying breakdowns, accidents and anomalies*: in my research I attended to invisible practices such as the buzzer and bleep systems. This ties in with how materials shape practice, and also how mundane processes become black-boxed or treated as matters of fact.

The last two points relate to analysing materialities. *Discovering the spectrum of human-technology-world relations*: my fifth point is about assembling realities and relates to the questions put forward for this heuristic in terms of human-technology-world relations.

*Unravelling translations*: this relates to the ontological politics of learning, my fourth point. This refers to how work is ordered and assembled and how different realities are enacted, including collateral realities.

### **Describing multiple worlds**

As I progressed with the research there were facets of multiple worlds that began to unfold for me. I had started with a praxiographic approach which helped me to notice difference, ambivalence and ambiguity in the data. This, for me, is where the advantage of ANT as non-representative becomes evident: if I had sought for generalization, or to claim that my research was representative of the sample, then difference might have been treated as ‘outlier’, ‘atypical’ or ‘confounder’. At the end of *The Body Multiple*, Mol (2002:152) observes:

Shifting from understanding objects as the focus point of various perspectives to following them as they are enacted in a variety of practices implies a shift from asking how sciences represent to asking how they intervene.

ANT enabled me to follow and unfold difference rather than try to smooth it over or to explain the phenomenon in the context of patterns that I had drawn out. Applying the ANT methodology to this process I could say that this was a method assemblage, taking into account that when something was made visible then something else might be made absent or other. I could also say that creating a meta-narrative would involve regulating difference in my own research. It is therefore appropriate that I did not follow a conventional analysis process for qualitative research of thematic analysis and coding. Although some degree of organisation and selection was involved, I tried to do this through sensitising to the data and visual analysis, creating descriptions and anecdotes.

My first anecdote exploring multiple worlds was the measurement of ‘duration’. I noticed this because the student encountered difficulties in recording a yes/no answer regarding whether or not it had been recorded, and it had appeared very straightforward at first. It took a long time to draw out descriptions from the data to describe why recording duration was so complex; at one point, my supervisor said that they were not convinced that this was an example of a multiplicity. It required further description to

present duration as a multiplicity, and a turning point came in an example in the data which demonstrated how practices appear to ‘peel away’ from each other into multiple worlds. It was unnerving to continue apply work and effort when there was a risk that nothing convincing would emerge, but this is the work of an ANT analyst: you have to hold your nerve. Law (2009:15), for example, explains how he explored non-coherence when studying a conference talk:

In practice, practices are always more or less non-coherent. They work by enacting different versions of reality and more or less successfully holding these together. But if there is multiplicity rather than singularity then we have an entry point. If we look for non-coherences within practices we will find them. We will discover collateral realities. And, this is the move to an ontological politics, we may take sides and hope to make a difference. Reality is no longer destiny.

At the end of my research, there were a few incidents that indicated not coherence but perhaps affinity or serendipity with ANT. The first was rather esoteric but felt significant to my role as an ANT researcher. The second is encouraging for future research.

#### *Story one*

I was in an airport and I picked up a book: *Labyrinths* by Borges (1964). I flicked through the pages and happened upon a story entitled *Avatars of the Tortoise*. I was drawn to the story, bought the book, and sat and read it straight away. The story included a description of Zeno’s paradox related to a race between Achilles and a tortoise: the philosophical argument was that, if the tortoise started first, Achilles would never catch him up because of diminishing returns, fracturing time and distance into an impossible infinity. When I read this I thought of ANT, of how complexity is unfolded, un-black-boxed, *ad infinitum*. When I returned home, I re-read some of the chapters from Latour’s (2005) *Reassembling the Social*, and there was Zeno. Latour described the same thing I had been thinking. Perhaps I had retained the name from my first reading; perhaps this was a coincidence; or perhaps we were thinking along the same lines.

*Story two*

Adams and Thompson's (2016) book *Researching a Posthuman World: Interviews with digital objects* came out in 2016, and I had avoided reading this straight away as I had already started my analysis. Instead, I finished writing the key points in Chapter 9 and then read the book. As I read through the heuristics, I found that many of these resonated with my own study. As I described earlier in this chapter, my five key points easily nestled in some of the heuristics, and it would not be difficult for a future study to start with the heuristics. I felt encouraged by this, again, as though I had returned.

Perhaps these stories describe the finish point as inevitable as a ball rolling down a hill; it will stop at the bottom, in a different place to where it started. Or perhaps it was like getting lost and coming back to the same point, but everything else has changed. Either way, it has been an interesting journey.

## References

Abrahamsson, S., Bertoni, F., Mol, A. and Martín, R.I. (2015) Living with omega-3: New materialism and enduring concerns. *Environment and Planning D: Society and Space*, 33 (1), pp. 4–19.

Adams, C. and Thompson, T.L. (2016) *Researching a posthuman world: interviews with digital objects*. London: Palgrave MacMillan.

Aherne, J. and Whelton, J. eds. (2010) *Applying lean in healthcare: a collection of international case studies*. Boca Raton, FL: CRC Press.

Ahn, S., Rimpiläinen, S., Theodorsson, A., Fenwick, T. and Dahlgren, M.A. (2015) Learning in technology-enhanced medical simulation: Locations and knowings. *Professions and Professionalism*, 5 (3).

Alexander, J.A. and Hearld, L.R. (2009) What can we learn from quality improvement research? A critical review of research methods. *Medical Care Research and Review: MCRR*, 66 (3), pp. 235–271.

Allen, D. (2013) Understanding context for quality improvement: Artefacts, affordances and socio-material infrastructure. *Health*: 17 (5), pp. 460–477.

Angrosino, M. (2007) *Doing ethnographic and observational research*. Los Angeles, CA: Sage.

Angrosino, M. and Rosenberg, J. (2011) Observations on observation. In: N.K. Denzin and Y.S. Lincoln, eds. *The Sage handbook of qualitative research*. 4<sup>th</sup> ed. London: Sage, pp. 467–478.

Anzul, M., Ely, M., Freidman, T., Garner, D. and McCormack-Steinmetz, A. (1991) *Doing qualitative research: circles within circles*. London: Routledge.

Armstrong, L., Lauder, W. and Shepherd, A. (2015) An evaluation of methods used to teach quality improvement to undergraduate healthcare students to inform curriculum development within preregistration nurse education: a protocol for systematic review and narrative synthesis. *Systematic Reviews*, 4 (1), pp. 8.

Askew, D., Cowan, S., Michael, N. and Semple, L., 2015. *2020 Framework for Quality, Efficiency and Value*. Edinburgh: Scottish Government.

Barad, K. (2007) *Meeting the universe halfway: quantum physics and the entanglement of matter and meaning*. Durham: Duke University Press.

Bate, P., Robert, G., Fulop, N., Øvertveit, J. and Dixon-Woods, M. (2014) *Perspectives on context: a selection of essays considering the role of context in successful quality improvement*. London: Health Foundation.

Benjamin, W., 1999. *The arcades project*. Cambridge: Harvard University Press.

Berg, M. and Goorman, E. (1999) The contextual nature of medical information. *International Journal of Medical Informatics*, 56 (1), pp. 51–60.

Bergs, J., Lambrechts, F., Simons, P., Vlayen, A., Marneffe, W., Hellings, J., Cleemput, I. and Vandijck, D. (2015) Barriers and facilitators related to the implementation of surgical safety checklists: a systematic review of the qualitative evidence. *BMJ Quality & Safety*, 24 (12), pp. 776–786.

Bhattacharyya, O., Reeves, S. and Zwarenstein, M. (2009) What is implementation research? Rationale, concepts, and practices. *Research on Social Work Practice*, 19 (5), pp. 491–502.

Bleakley, A. (2012) The proof is in the pudding: putting actor-network-theory to work in medical education. *Medical Teacher*, 34 (6), pp. 462–467.

Bleakley, A., (2014) *Patient-centred medicine in transition: the heart of the matter*. Vol. 3. Heidelberg: Springer Science & Business Media.



- Bleakley, A., Bligh, J. and Browne, J. (2011) *Medical education for the future: identity, power and location*. Heidelberg: Springer Science & Business Media.
- Borges, J.L. (1964) *Labyrinths: selected stories & other writings*. London: New Directions Publishing.
- Borges, J.L. (1974) The analytical language of John Wilkins. In: R.L.C. Simms, trans. *Other Inquisitions, 1937–1952*. Austin, TX: University of Texas Press, pp. 101–105.
- Boud, D. and Hager, P. (2012) Re-thinking continuing professional development through changing metaphors and location in professional practices. *Studies in Continuing Education*, 34 (1), pp. 17–30.
- Brown, J.S. and Duguid, P. (1991) Organizational learning and communities-of-practice: toward a unified view of working, learning, and innovation. *Organization Science*, 2 (1), pp. 40–57.
- Brown, S.D. (2002) Michel Serres. *Theory, Culture & Society*, 19 (3), pp. 1–27.
- Brown, S.D. and Capdevila, R. (1999) Perpetuum mobile: substance, force and the sociology of translation. *The Sociological Review*, 47 (S1), pp. 26–50.
- Bruni, A. (2005) Shadowing software and clinical records: on the ethnography of non-humans and heterogeneous contexts. *Organization*, 12 (3), pp. 357–378.
- Buchan, S., Regan, K., Filion-Murphy, C., Little, K., Strath, A., Rowe, I. and Vosper, H. (2014) Students as partners in a quality improvement approach to learning enhancement: a case study from a pharmacy undergraduate course. *Communicare*, 1 (1).
- Butler-Kisber, L. and Poldma, T. (2011) The power of visual approaches in qualitative inquiry: the use of collage making and concept mapping in experiential research. *Journal of Research Practice*, 6 (2), pp. 1–16.

Callon, M. (1984) Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay. *The Sociological Review*, 32 (1 suppl), pp. 196–233.

Carney, B.T., West, P., Neily, J., Mills, P.D. and Bagian, J.P. (2010) Differences in nurse and surgeon perceptions of teamwork: implications for use of a briefing checklist in the OR. *AORN Journal*, 91 (6), pp. 722–729.

Clarke, J. (2002) A new kind of symmetry: actor-network theories and the new literacy studies. *Studies in the Education of Adults*, 34 (2), pp. 107–122.

Cleland, J. and Durning, S.J. eds. (2015) *Researching Medical Education*. Chichester: John Wiley & Sons.

Collins, H. and Yearly, S. (1992) Epistemological chicken. In: A. Pickering, ed. *Science as Practice and Culture*. Chicago: The University of Chicago Press, pp. 301–326.

Contu, A. and Willmott, H. (2003) Re-embedding situatedness: the importance of power relations in learning theory. *Organization Science*, 14 (3), pp. 283–296.

Crang, M. (2003) Telling materials. In: M. Pryke, G. Rose and S. Whatmore, eds. *Using social theory: thinking through research*. London: SAGE Publications, pp. 127–162.

Cresswell, K.M., Worth, A. and Sheikh, A. (2010) Actor-Network Theory and its role in understanding the implementation of information technology developments in healthcare. *BMC Medical Informatics and Decision Making*, 10 (67).

Dahlgren, M.A., Dahlgren, L.O. and Dahlberg, J. (2012) Learning professional practice through education. In: P. Hager, A. Lee and A. Reich, eds. *Practice, learning and change: practice-theory perspectives on professional learning*. Dordrecht: Springer, pp. 183–197.

Damschroder, L.J., Aron, D.C., Keith, R.E., Kirsh, S.R., Alexander, J.A. and Lowery, J.C. (2009) Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implementation Science*, 4 (50).

Davey, P., Tully, V., Grant, A., Day, R., Ker, J., Marr, C., Mires, G. and Nathwani, D. (2013) Learning from errors: what is the return on investment from training medical students in incident review? *Clinical Risk*, 19 (1), pp. 1–5.

Davidoff, F. and Batalden, P. (2005) Toward stronger evidence on quality improvement. Draft publication guidelines: the beginning of a consensus project. *Quality & Safety in Health Care*, 14 (5), pp. 319–325.

De Freitas, E. (2012) The classroom as rhizome: new strategies for diagramming knotted interactions. *Qualitative Inquiry*, 18 (7), pp. 557–570.

Decuyper, M. and Simons, M. (2016) Relational thinking in education: topology, sociomaterial studies, and figures. *Pedagogy, Culture & Society*, 24 (3), pp. 371–386.

Denzin, N.K. and Lincoln, Y.S. eds. (2005) *The Sage handbook of qualitative research*. 3<sup>rd</sup> ed. Thousand Oaks, CA: Sage.

Donabedian, A. (1980). *The definition of quality and approaches to its assessment: explorations in quality assessment and monitoring*. Vol. 1. Chicago: Health Administration Press.

Dornan, T., Scherpbier, A. and Boshuizen, H. (2009) Supporting medical students' workplace learning: experience-based learning (ExBL). *The Clinical Teacher*, 6 (3), pp. 167–171.

Economic and Social Research Council (2017), *What is impact?* Available: <http://www.esrc.ac.uk/research/evaluation-and-impact/what-is-impact/> (Accessed 11<sup>th</sup> November 2017).

Edwards, R., Biesta, G. and Thorpe, M. (2009) *Rethinking contexts for learning and teaching*. Abingdon: Routledge.

Engeström, Y. (2001) Expansive learning at work: Toward an activity theoretical reconceptualization. *Journal of Education and Work*, 14 (1), pp. 133–156.

The Evidence Centre (2011) *Evidence scan: improvement Science*. London: The Health Foundation. Available at: [http://www.health.org.uk/sites/health/files/Improvement Science.pdf](http://www.health.org.uk/sites/health/files/Improvement%20Science.pdf) (Accessed: 11 November 2017).

Fairclough, N. (2003) *Analysing discourse: textual analysis for social research*. London: Routledge.

Falk, A.L., Hopwood, N. and Dahlgren, M.A. (2017) Unfolding practices: a sociomaterial View of interprofessional collaboration in health care. *Professions and Professionalism*, 7 (2).

Fenwick, T. (2009) Making to measure? Reconsidering assessment in professional continuing education. *Studies in Continuing Education*, 31 (3), pp. 229–244.

Fenwick, T. (2011) Reading educational reform with actor network theory: fluid spaces, otherings, and ambivalences. *Educational Philosophy and Theory*, 43 (s1), pp. 114–134.

Fenwick, T. (2014a) Knowledge circulations in inter-para/professional practice: a sociomaterial enquiry. *Journal of Vocational Education & Training*, 66 (3), pp. 264–280.

Fenwick, T. (2014b) Sociomateriality in medical practice and learning: attuning to what matters. *Medical Education*, 48 (1), pp. 44–52.

Fenwick, T. and Edwards, R. (2010) *Actor-network theory in education*. London: Routledge.

Fenwick, T. and Edwards, R. eds. (2012) *Researching education through actor-network theory*. Chichester: John Wiley & Sons.

Fenwick, T., Edwards, R. and Sawchuk, P. (2011) *Emerging approaches to educational research: tracing the socio-material*. Abingdon: Routledge.

Fenwick, T. and Landri, P. (2012) Materialities, textures and pedagogies: socio-material assemblages in education. *Pedagogy, Culture & Society*, 20 (1), pp. 1–7.

Fenwick, T. and Nerland, M. (2014) *Reconceptualising professional learning: sociomaterial knowledges, practices and responsibilities*. Abingdon: Routledge.

Fenwick, T., Nerland, M. and Jensen, K. eds. (2014) *Professional Learning in Changing Contexts*. Oxon: Routledge.

Fenwick, T. and Nimmo, G.R. (2015) Making visible what matters: sociomaterial approaches for research and practice in healthcare education. In: J. Cleland and S.J. Durning, eds. *Researching Medical Education*, Chichester: John Wiley & Sons, pp. 67–80.

Flyvbjerg, B. (2011) Case study. In: N.K. Denzin and Y.S. Lincoln, eds. *The Sage handbook of qualitative research*. 4<sup>th</sup> ed. London: Sage, pp. 301–316.

Fox, S. (1990) Becoming an ethnomethodology user: learning a perspective in the field. In: R. Burgess, ed. *Studies in Qualitative Methodology: Reflections on Field Experience*. London: Jai Press, pp. 1–23.

Fox, S. (2000) Communities of practice, Foucault and actor-network theory. *Journal of Management Studies*, 37 (6), pp. 853–868.

Gabbay, J., le May, A., Connell, C. and Klein, J.H. (2014) Skilled for improvement? The improvement skills pyramid. London: The Health Foundation. Available: [http://www.health.org.uk/sites/health/files/SkilledForImprovement\\_pyramidtemplate.pdf](http://www.health.org.uk/sites/health/files/SkilledForImprovement_pyramidtemplate.pdf) (Accessed 11 November 2017).

Gehm, S., Husemann, P. and von Wilcke, K. eds. (2015) *Knowledge in motion: perspectives of artistic and scientific research in dance*. Bielefeld: Transcript Verlag.

General Medical Council Education Committee (1993) *Tomorrow's doctors: recommendations on undergraduate medical education*. London: General Medical Council.

Gherardi, S. (2012) Why do practices change and why do they persist? Models of explanations. In: P. Hager, A. Lee and A. Reich, eds. *Practice, learning and change: practice-theory perspectives on professional learning*. Dordrecht: Springer, pp. 217–231.

Gherardi, S., Nicolini, D. and Odella, F. (1998) Toward a social understanding of how people learn in organizations: the notion of situated curriculum. *Management Learning*, 29 (3), pp. 273–297.

Gillam, S. and Siriwardena, A.N. (2014) *Quality improvement in primary care: the essential guide*. London: Radcliffe Publishing Ltd.

Goldszmidt, M. and Faden, L. (2016) Is medical education ready to embrace the socio-material? *Medical Education*, 50 (2), pp. 162–164.

Gorur, R. (2012) ANT on the PISA Trail: following the statistical pursuit of certainty. In: T. Fenwick, and R. Edwards, eds. (2012) *Researching education through actor-network theory*. Chichester: John Wiley & Sons, pp. 60–77.

Grant, A., Kinnersley, P. and Field, M. (2012) Learning contexts at two UK medical schools: a comparative study using mixed methods. *BMC Research Notes*, 5 (153).

Grant, A., Prout, H., Hawthorne, K., Jones, T.L. and Houston, H. (2010) Some effects of teaching undergraduate medical students on general practitioner thinking and learning. *Education for Primary Care*, 21 (2), pp. 97–104.

Greenhalgh, T., Annandale, E., Ashcroft, R., Barlow, J., Black, N., Bleakley, A., Boaden, R., Braithwaite, J., Britten, N. and Carnevale, F. (2016) An open letter to The BMJ editors on qualitative research. *BMJ*, 352 (i563).

Greenhalgh, T., Wong, G., Westhorp, G. and Pawson, R. (2011) Protocol–realist and meta-narrative evidence synthesis: evolving standards (RAMESES). *BMC Medical Research Methodology*, 11 (115).

Hager, P., Lee, A. and Reich, A. (2012) Problematising practice, reconceptualising learning and imagining change. In: P. Hager, A. Lee and A. Reich, eds. *Practice, learning* pg. 230

*and change: practice-theory perspectives on professional learning*. Dordrecht: Springer, pp. 1–14.

Ham, C. (2004) *Health policy in Britain: the politics and organisation of the National Health Service*. 5<sup>th</sup> ed. Public Policy and Politics. Basingstoke: Palgrave Macmillan.

Hammersley, M. (1993) *Social research: philosophy, politics and practice*. London: Sage.

Harman, G. (2010) *Prince of networks: Bruno Latour and metaphysics*. Melbourne: re.press.

Harris, M. (1976) History and significance of the emic/etic distinction. *Annual Review of Anthropology*, 5 (1), pp. 329–350.

Hassard, J., Kelemen, M. and Cox, J.W. (2012) *Disorganization theory: explorations in alternative organizational analysis*. London: Routledge.

Haynes, A.B., Weiser, T.G., Berry, W.R., Lipsitz, S.R., Breizat, A.S., Dellinger, E.P., Herbosa, T., Joseph, S., Kibatala, P.L. and Lapitan, M.C.M. (2009) A surgical safety checklist to reduce morbidity and mortality in a global population. *New England Journal of Medicine*, 360 (5), pp. 491–499.

Healthcare Improvement Scotland and Scottish Patient Safety Programme (2009) Prevention of Catheter Associated Urinary Tract Infections (CAUTI) Driver Diagram and Change Package. Available: <http://ihub.scot/spsp/acute-adult/catheter-associated-urinary-tract-infection-cauti/> (Accessed: 14 November 2017).

Holden, R.J., Carayon, P., Gurses, A.P., Hoonakker, P., Hundt, A.S., Ozok, A.A. and Rivera-Rodriguez, A.J. (2013) SEIPS 2.0: A human factors framework for studying and improving the work of healthcare professionals and patients. *Ergonomics*, 56 (11), pp. 1669–1686.

Ibrahim, E.F., Richardson, M.D. and Nestel, D. (2015) Mental imagery and learning: a qualitative study in orthopaedic trauma surgery. *Medical Education*, 49 (9), pp. 888–900.

The Institute for Healthcare Improvement (2015) *Initiatives: Scottish Patient Safety Programme*. Available:

<http://www.ihl.org/Engage/Initiatives/Completed/ScottishPatientSafety/Pages/default.aspx> (Accessed: 11 November 2017).

The Institute for Healthcare Improvement (2017) *Open School. IHI Open School Online Courses: Quality improvement practicum*. Available: <http://www.ihl.org/education/IHIOpenSchool/Courses/Pages/Practicum.aspx> (Accessed 11 November 2017).

James, B., Beattie, M., Shepherd, A., Armstrong, L. and Wilkinson, J. (2016) Time, fear and transformation: student nurses' experiences of doing a practicum (quality improvement project) in practice. *Nurse Education in Practice*, 19, pp. 70–78.

Johnson, J. (1988) Mixing humans and nonhumans together: the sociology of a door-closer. *Social Problems*, 35 (3), pp. 298–310.

Kanger, L. (2017) Mapping 'the ANT multiple': a comparative, critical and reflexive analysis. *Journal for the Theory of Social Behaviour*, early view online. doi: 10.1111/jtsb.12147

Kincheloe, J.L., McLaren, P. and Steinberg, S.R. (2011) Critical pedagogy and qualitative research. In: N.K. Denzin and Y.S. Lincoln, eds. *The Sage handbook of qualitative research*. 4<sup>th</sup> ed. London: Sage, pp. 163–177.

Kuper, A., Whitehead, C. and Hodges, B.D. (2013) Looking back to move forward: using history, discourse and text in medical education research: AMEE Guide No. 73. *Medical Teacher*, 35 (1), pp. e849–e860.

Landri, P. (2012) A return to practice: practice-based studies of education. In: P. Hager, A. Lee and A. Reich, eds. *Practice, learning and change: practice-theory perspectives on professional learning*. Dordrecht: Springer, pp. 85–100.

Langley, G.J., Moen, R.D., Nolan, K.M., Nolan, T.W., Norman, C.L. and Provost, L.P. (2009) *The improvement guide: a practical approach to enhancing organizational performance*. 2<sup>nd</sup> ed. San Francisco, CA: Jossey-Bass.



Latour, B. (1987) *Science in action: how to follow scientists and engineers through society*. Cambridge, MA: Harvard University Press.

Latour, B. (1993) *The pasteurization of France*. Cambridge, MA: Harvard University Press.

Latour, B. (1999a) On recalling ANT. In: J. Law and J. Hassard, eds. *Actor network theory and after*. Oxford: Blackwell Publishing, pp. 15–25.

Latour, B. (1999b) *Pandora's hope: essays on the reality of science studies*. Cambridge, MA: Harvard University Press.

Latour, B. (2004) Why has critique run out of steam? From matters of fact to matters of concern. *Critical Inquiry*, 30 (2), pp. 225–248.

Latour, B. (2005) *Reassembling the social: an introduction to actor-network-theory*. Oxford: Oxford University Press.

Latour, B. (2012) *We have never been modern*. Cambridge, MA: Harvard University Press.

Latour, B. and Porter, C. (1996) *Aramis, or, the love of technology*. Cambridge, MA: Harvard University Press.

Latour, B. and Woolgar, S. (2013) *Laboratory life: the construction of scientific facts*. Princeton, NJ: Princeton University Press.

Lave, J. and Wenger, E. (1991) *Situated learning: legitimate peripheral participation*. Cambridge: Cambridge University Press.

Law, J. (1992) Notes on the theory of the actor-network: ordering, strategy, and heterogeneity. *Systemic Practice and Action Research*, 5 (4), pp. 379–393.

Law, J. (1994) *Organizing modernity*. Blackwell Oxford.

Law, J. (1999) After ANT: Complexity, naming and topology. In: Law, J. and Hassard, J. (eds), *Actor Network Theory and After*. Oxford: Blackwell Publishing, pp. 1–14.

Law, J. (2004a) And if the global were small and noncoherent? Method, complexity, and the baroque. *Environment and Planning D: Society and Space*, 22 (1), pp. 13–26.

Law, J. (2004b) *After method: mess in social science research*. London: Routledge.

Law, J. (2006) Traduction/trahison: notes on ANT. *Convergencia, UAEM, Mexico*, (42), pp. 32–57.

Law, J. (2009) ‘Collateral Realities’, version of 29th December 2009. Available: <http://www.heterogeneities.net/publications/Law2009CollateralRealities.pdf> (Accessed: 11 November 2017).

Law, J. and Singleton, V. (2000) *This is not an object*. Lancaster University Centre for Science Studies.

Law, J. and Singleton, V. (2003) Allegory and its others. In: D. Nicolini, S. Gherardi and D. Yanow, eds. *Knowing in Organizations: A Practice-Based Approach*. Armonk, NY: M.E. Sharpe, pp. 225–254.

Law, J. and Hassard, J. eds. (1999) *Actor network theory and after*. Oxford: Blackwell Publishers.

Lincoln, Y.S., Lynham, S.A. and Guba, E.G. (2011) Paradigmatic controversies, contradictions, and emerging confluences, revisited. In: N.K. Denzin and Y.S. Lincoln, eds. *The Sage handbook of qualitative research*. 4<sup>th</sup> ed. London: Sage, pp. 97–128.

Lindsay, B. (2007) *Understanding research and evidence-based practice*. Exeter: Reflect Press.

Lucas, B. and Nacer, H. (2015) *The habits of an improver: thinking about learning for improvement in healthcare*. Discussion Paper. London: The Health Foundation.

- Martin, A.D. and Kamberelis, G. (2013) Mapping not tracing: qualitative educational research with political teeth. *International Journal of Qualitative Studies in Education*, 26 (6), pp. 668–679.
- Mason, P. and Butler, C.C. (2010) *Health Behavior Change E-Book*. Edinburgh: Elsevier Health Sciences.
- May, C.R., Johnson, M. and Finch, T. (2016) Implementation, context and complexity. *Implementation Science*, 11 (141).
- McCann, L., Hassard, J.S., Granter, E. and Hyde, P.J. (2015) Casting the lean spell: the promotion, dilution and erosion of lean management in the NHS. *Human Relations*, 68 (10), pp. 1557–1577.
- McKimm, J., Forrest, K. and Thistlethwaite, J. (2017) *Medical education at a glance*. Chichester: John Wiley & Sons.
- McLean, C. and Hassard, J. (2004) Symmetrical absence/symmetrical absurdity: critical notes on the production of actor-network accounts. *Journal of Management Studies*, 41 (3), pp. 493–519.
- McMurtry, A., Rohse, S. and Kilgour, K.N. (2016) Socio-material perspectives on interprofessional team and collaborative learning. *Medical Education*, 50 (2), pp. 169–180.
- Michael, M. (1996) *Constructing identities: the social, the nonhuman and change*. London: Sage.
- Miettinen, R. (1999) The riddle of things: activity theory and actor-network theory as approaches to studying innovations. *Mind, Culture, and Activity*, 6 (3), pp. 170–195.
- Miller, P. (1997) The multiplying machine. *Accounting, Organizations and Society*, 22 (3–4), pp. 355–364.

Mitchell, B., Cristancho, S., Nyhof, B.B. and Lingard, L.A. (2017) Mobilising or standing still? A narrative review of Surgical Safety Checklist knowledge as developed in 25 highly cited papers from 2009 to 2016. *BMJ Quality & Safety*, 26 (10).

Mol, A. (1998) Ontological politics. A word and some questions. *The Sociological Review*, 46 (S), pp. 74–89.

Mol, A. (2002) *The body multiple: ontology in medical practice*. Durham: Duke University Press.

Mol, A. (2010) Actor-network theory: sensitive terms and enduring tensions. *Kölner Zeitschrift Für Soziologie Und Sozialpsychologie.Sonderheft*, 50, pp. 253–269.

Mulcahy, D. (1999) (actor-net) Working bodies and representations: tales from a training field. *Science, Technology, & Human Values*, 24 (1), pp. 80–104.

Mulcahy, D. (2014) Re-thinking teacher professional learning: more than a representational account. In: T. Fenwick and M. Nerland, eds. *Reconceptualising professional learning: sociomaterial knowledges, practices and responsibilities*. Abingdon: Routledge, pp. 52–66.

Nespor, J. (2012) Devices and educational change. In: T. Fenwick, and R. Edwards, eds. (2012) *Researching education through actor-network theory*. Chichester: John Wiley & Sons, pp. 1–22.

Nespor, J. (2014) *Knowledge in motion: space, time and curriculum in undergraduate physics and management*. Abingdon: Routledge.

Nietzsche, F. (2003) *Beyond good and evil*. London: Penguin.

Okwemba, S. and Copeland, L. (2014) Improving Mental Status Questionnaire (MSQ) completion on admission to the Acute Surgical Receiving Unit (ASRU), Ninewells Hospital, Dundee. *BMJ Quality Improvement Reports*, 3 (1), u205217–w2159.

Parker, H. (2016) *Anatomy of a soldier: a novel*. London: Faber and Faber.

Paterson, G., Rossi, J., MacLean, S., Dolan, R., Johnston, T., Linden, D., Arbuckle, S., Lynch, N. and Davey, P. (2011) A patient safety 'Student Selected Component' at the University of Dundee (UK). *International Journal of Clinical Skills*, 5 (2).

Peden, C. and Rooney, K. (2009) The science of improvement as it relates to quality and safety in the ICU. *Journal of the Intensive Care Society*, 10 (4), pp. 260–264.

Pels, D. (1996) The politics of symmetry. *Social Studies of Science*, 26 (2), pp. 277–304.

Powell, A., Rushmer, R. and Davies, H. (2009) *A systematic narrative review of quality improvement models in health care*. Edinburgh: NHS Quality Improvement Scotland.

Price, O.M., Johnsson, M.C., Scheeres, H., Boud, D. and Solomon, N. (2012) Learning organizational practices that persist, perpetuate and change: a Schatzkian view. In: P. Hager, A. Lee and A. Reich, eds. *Practice, learning and change: practice-theory perspectives on professional learning*. Dordrecht: Springer, pp. 233–247.

Pring, R. and Thomas, G. (2004) *Evidence-based practice in education*. Maidenhead: McGraw-Hill International.

Prosser, J. (2011) Visual methodology: toward a more seeing research. In: N.K. Denzin and Y.S. Lincoln, eds. *The Sage handbook of qualitative research*. 4<sup>th</sup> ed. London: Sage, pp. 479–496.

Punch, S. (2012) Hidden struggles of fieldwork: exploring the role and use of field diaries. *Emotion, Space and Society*, 5 (2), pp. 86–93.

Ragin, C.C. and Becker, H.S. eds. (1992) *What is a case? Exploring the foundations of social inquiry*. Cambridge: Cambridge University Press.

Reich, A. and Girdwood, J. (2012) Governing learning practices: governmentality and practices. In: P. Hager, A. Lee and A. Reich, eds. *Practice, learning and change: practice-theory perspectives on professional learning*. Dordrecht: Springer, pp. 151–165.

Roberts, J. (2006) Limits to communities of practice. *Journal of Management Studies*, 43 (3), pp. 623–639.

Rowe, A. and Chapman, C. (2015) *Perspectives on improvement and effectiveness: key definitions and concepts*. Edinburgh: What Works Scotland. Available: <http://whatworksscotland.ac.uk/wp-content/uploads/2015/11/Perspectives-on-Improvement.pdf> (Accessed: 11 November 2017).

Sayes, E. (2014) Actor–Network Theory and methodology: just what does it mean to say that nonhumans have agency? *Social Studies of Science*, 44 (1), pp. 134–149.

The Scottish Government (2010) *The Healthcare Quality Strategy for NHSScotland*. Edinburgh: The Scottish Government. Available: <http://www.gov.scot/resource/doc/311667/0098354.pdf> (Accessed: 11 November 2017).

The Scottish Government (2016) *HEAT Targets 14/15*. Edinburgh: The Scottish Government. Available: <http://www.gov.scot/About/Performance/scotPerforms/NHSScotlandperformance/HEAT1415> (Accessed 11 November 2017).

Scottish Medicines Consortium (2017) *About the Scottish Antimicrobial Prescribing Group (SAPG)*. Available: <https://www.scottishmedicines.org.uk/SAPG> (Accessed: 11 November 2017).

Silverman, D. (2000) Analyzing talk and text. In: N.K. Denzin and Y.S. Lincoln, eds. *The Sage handbook of qualitative research*, 2<sup>nd</sup> ed. Thousand Oaks, CA: Sage Publications, pp. 821–834.

Sørensen, E. (2009) *The materiality of learning: technology and knowledge in educational practice*. Cambridge: Cambridge University Press.

Stake, R.E. (2013) *Multiple case study analysis*. New York: The Guilford Press.

Star, S.L. (1990) Power, technology and the phenomenology of conventions: on being allergic to onions. *The Sociological Review*, 38 (S1), pp. 26–56.

- Strathern, M. (2005) *Partial connections*. Walnut Creek, CA: Altamira Press.
- Tannahill, A. (2008) Beyond evidence—to ethics: a decision-making framework for health promotion, public health and health improvement. *Health Promotion International*, 23 (4), pp. 380–390.
- Thompson, D.S., Fazio, X., Kustra, E., Patrick, L. and Stanley, D. (2016) Scoping review of complexity theory in health services research. *BMC Health Services Research*, 16 (87).
- Turbitt, I., Mathias, M. and de Jong, J. (2010) The Kafka Brigade: Public Management Theory in Practice. Kafka Brigade paper, Winelands Conference 2010, File 2. doi: 10.13140/RG.2.1.2304.4329
- University of Stirling, Department of Health Sciences (2015) *Advanced Practice Masters Degree*. Available: <http://www.stir.ac.uk/postgraduate/programme-information/prospectus/health-sciences/advanced-practice/> (Accessed: 11 November 2017).
- Verran, H. (2001) *Science and an African logic*. Chicago, IL: University of Chicago Press.
- Whitehead, C.R., Hodges, B.D. and Austin, Z. (2013) Dissecting the doctor: from character to characteristics in North American medical education. *Advances in Health Sciences Education*, 18 (4), pp. 687–699.
- Wong, B.M., Etchells, E.E., Kuper, A., Levinson, W. and Shojanian, K.G. (2010) Teaching quality improvement and patient safety to trainees: a systematic review. *Academic Medicine: Journal of the Association of American Medical Colleges*, 85 (9), pp. 1425–1439.
- Worrall, M. (2008) Chocks away? Time for a surgical checklist. *The Bulletin of the Royal College of Surgeons of England*, 90 (9), pp. 304–305.
- Zukas, M. and Kilminster, S. (2012) Learning to practise, practising to learn: doctors' transitions to new levels of responsibility. In: P. Hager, A. Lee and A. Reich, eds.

*Practice, learning and change: practice-theory perspectives on professional learning.*  
Dordrecht: Springer, pp. 199–213.

Zukas, M. and Kilminster, S. (2014) The doctor and the blue form: learning professional responsibility. In: T. Fenwick and M. Nerland, eds. *Reconceptualising professional learning: sociomaterial knowledges, practices and responsibilities.* Abingdon: Routledge, pp. 38–51.



## Appendix 1: Consent and information forms

## Consent Form

**Title of Project:** Learning and Workplace Practices of Improvement Science

**Details of Researcher:**

Bethan Mitchell  
ESRC PhD Candidate  
School of Education  
University of Stirling  
FK9 4LA  
E: bethan.mitchell1@stir.ac.uk

**Details of Research Supervisor:**

Professor Tara Fenwick  
Director of Research and Knowledge  
Exchange  
School of Education  
University of Stirling  
FK9 4LA  
E: tara.fenwick@stir.ac.uk

1. I confirm that I have read and understand the Information Form for the above study and have had the opportunity to ask questions.
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason.
3. I consent to interviews being audio-recorded.
4. I understand that copies of transcripts may be made available to me for my information; if there is anything I wish to discuss I can do so with the researcher.
5. I understand that participants will be anonymised in any publications that arise from this research.
6. I agree / do not agree (delete as applicable) to take part in the above study.

\_\_\_\_\_  
Name of Participant

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Researcher

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature

One copy to be retained by participant, one copy to be held by researcher.

This research has been approved by the Research Ethics Committee of the University of Stirling. Questions and concerns are directed to:

## Participant Information Form

**Title of Project:** Learning and Workplace Practices of Improvement Science

**Name of Researcher:** Bethan Mitchell

You are being asked to take part in a research study being conducted by myself, Bethan Mitchell, under the supervision of Professor Tara Fenwick, both of the University of Stirling.

The purpose of the study is to take a detailed look at practices that occur in the workplace as a medical student (you) conducts an Improvement Science project (your project). The focus will be on associations and relations of people and objects that are involved in this process, with a view to highlighting actions and practices that might go unnoticed using alternative research approaches.

Participation in this research will be of benefit to student as it will encourage different perspectives of workplace practice, which is critical to identifying and implementing improvements. It will be of benefit to staff as these insights will help to make improvements more thoughtful and meaningful in relation to their needs.

The study will require the researcher to be present with the student for two half days per week while they conduct their IS project. In addition, an interview will be conducted prior to the visits which will give the student the opportunity to outline their own work. Because the emphasis is on relations and practice, the time on site will not necessarily be spent solely with the participant.

There are no known risks to the participant as part of this study.

It is within your rights to withdraw from the study at any time without explanation or penalty.

The data collected about you will not be linked to any personal information. The data will only be used by the researcher and no-one else. The written version of the research will not contain information that might identify you as the participant.

I will be happy to answer questions at any time. My email address is [bethan.mitchell1@stir.ac.uk](mailto:bethan.mitchell1@stir.ac.uk). If you would like to contact the university direct, please use the following details:

The Research Ethics Committee of the University of Stirling has reviewed and approved this research study.

## Staff Information Form

**Title of Project: Learning and Workplace Practices of Improvement Science**

**Name of Researcher: Bethan Mitchell**

I am conducting a study as part of my PhD at the University of Stirling.

The purpose of my study is to look at practices in the workplace as a medical student conducts an Improvement Science project. The focus is on associations and relations of people and objects that are involved in this process, with a view to highlighting actions and practices that might go unnoticed using alternative research approaches.

It is intended that this research will be of benefit to students and staff as it will encourage different perspectives of workplace practice, which is critical to identifying and implementing improvements. It will be of benefit to staff as these insights will help to make improvements more thoughtful and meaningful in relation to their needs.

The study will require the researcher to be present with the student for two half days per week while they conduct their IS project. Because the emphasis is on relations and practice, the time on site will not necessarily be spent solely with the participant. I am particularly interested in the interactions that occur in practice, and this will involve observing people and objects.

The data collected will not be linked to any personal information. The data will only be used by the researcher and no-one else. The written version of the research will not contain information that might identify individuals.

If you would like to know more about the project, please approach me. I am happy to provide more information. I am grateful to you for having me as a guest in your workplace. If this causes any inconvenience or discomfort, please let me know immediately. If you would like to contact me by email my address is: [bethan.mitchell1@stir.ac.uk](mailto:bethan.mitchell1@stir.ac.uk)

If you would like to contact my University direct, the contact details are:

The University Research Ethics Committee of the University of Stirling has reviewed and approved this research study.

## Appendix 2: Photomontages

A whiteboard outside a side-room above the dig-board with medical notes, including the TPAK. This was our first post-call. The student looked at this for data for her form, then checked it against patient notes, which were located in the ring-binders. The students tried different ways to do this: 1) by looking first at all the digboards outside the side-rooms, then by doing one room at a time, checking the patient notes each time.



The nurses' station at the entrance to the ward. Some ring-binders with patient notes are on the reception desk.



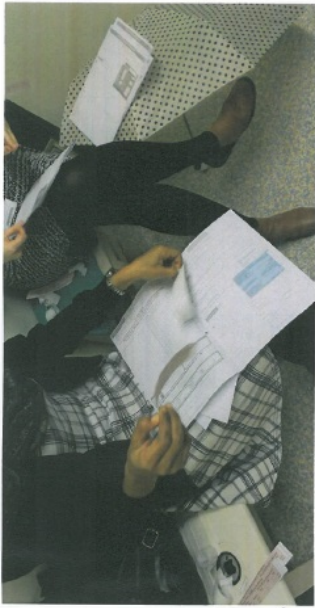
The corridor was traversed by Student 1 and myself, so it led to the Doctors' Office, at the top on the right. We made our way up and down to collect data from patient notes and the medical notes. Sometimes information was put on a trolley, sometimes in the Doctors' Office and sometimes at the nurses' station. This was because of the different clinicians needing to access information.

One of the whiteboards with patient details above the slide rail supporting a double-clipboards with the medical notes.



The views down the other corridor. In the foreground is the medication trolley. A nurse in a red apron (signalling not to disturb the) administrators medication at specific times of day. The TPAK is required to do this.

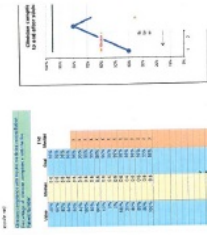
An umbrella & an iPad being used as tables...



No chairs available!



Tell them where to stick it! Having the materials dispersed on cards and officers on different floors required the students to take initiative when it came to finding suitable spaces.



Another tool - but how useful is it? The students got their head round the run chart, but with so few points it was hard to make a case.

Spaces outside the ward; chart? work on team 15 project electronically & on paper

Who would have thought making a sticker would be such a bother? The girl who cut the stickers out the stickers they would have been useless; also the students need a colour printer, sticker paper, access to the office... And all these - Critical.



The toilet room became an important site that had a huge impact on way of working.

Healthcare Name & Service	Location	Start Date	End Date	Status
...	...	...	...	...

One of many sticker versions



The waiting area outside one of the wards proved to be useful... Chairs used as a table!



The blue Promade... we spent lots of time here

...	...	...	...	...
...	...	...	...	...

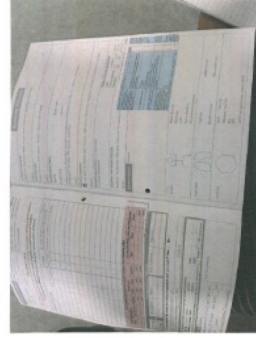
The students were far flung, so keeping up to date on the Slack network was useful



It took a while to get the right sticker 'infection pick'



The HTI provided blank sheets so that the students could follow and record all of the steps



The blue sticker - an example of what happens when the guillotine isn't used properly.

Chairs used as a table!






## Appendix 3: IHI Open School Practicum Templates

## IHI Open School Practicum Forms

The students from Cohort 2 were required to first submit a 'Charter' to outline their improvement project:

CHARTER FORM		
Name:	[REDACTED]	
Team Members:	[REDACTED]	
Project Title:	To explore the relationship between medicine reconciliation compliance and the accuracy of insulin prescription on the rate of hypoglycaemia in patients who are insulin dependant and admitted to [REDACTED]	
University/Organization Name:	[REDACTED]	
Health System Sponsor Name:	[REDACTED]	
<b>What are we trying to accomplish?</b>		
Aim statement (How good? For whom? By when? 1-2 sentences):		
The aim of this project is to decrease the rate of hypoglycaemia in insulin dependent patients on the [REDACTED] during the first 72 hours of admission by 50% within four weeks. However this is part of an extended piece of work which will work towards the same goal, span over six months and include all surgical wards within [REDACTED]		
Problem to be addressed (Defines WHAT broadly; 2-3 sentences)		
Insulin is a high risk medication which requires a system of medicine reconciliation, prescribing and dispensing,		

Once the project is approved, the students plan what they are going to do, go onto the ward to 'test' the improvement, study the outcomes, and then adjust the plan in a 'Plan, Do, Study, Act' (PDSA) cycle:

### PDSA(3) Worksheet for Testing Change

**Aim:** Implanting the use of insulin sticker by the [REDACTED] clinicians while admitting insulin dependent patients.

*Every goal will require multiple smaller tests of change*

Describe your first (or next) test of change:	Person responsible	When to be done	Where to be done
- Roleplay a mock stimulation test to fill in the stickers by the [REDACTED] clinician.	[REDACTED]	Thursday afternoon	[REDACTED]

#### Plan

List the tasks needed to set up this test of change	Person responsible	When to be done	Where to be done
- Print out insulin stickers. - Prepare 3 different scenarios of diabetic patients on insulin being admitted to the [REDACTED] - Engage 3 of clinician in the test. - Get their feedback using the 'sticker feedback from'	[REDACTED]	Thursday afternoon	[REDACTED]

Predict what will happen when the test is carried out	Measures to determine if prediction succeeds
- [REDACTED] clinician will engage in the test (at least 1). - Will get some feedback about the stickers.	- Number of Insulin stickers that will be filled by clinician. - Number of sticker feedback form which we will fill.

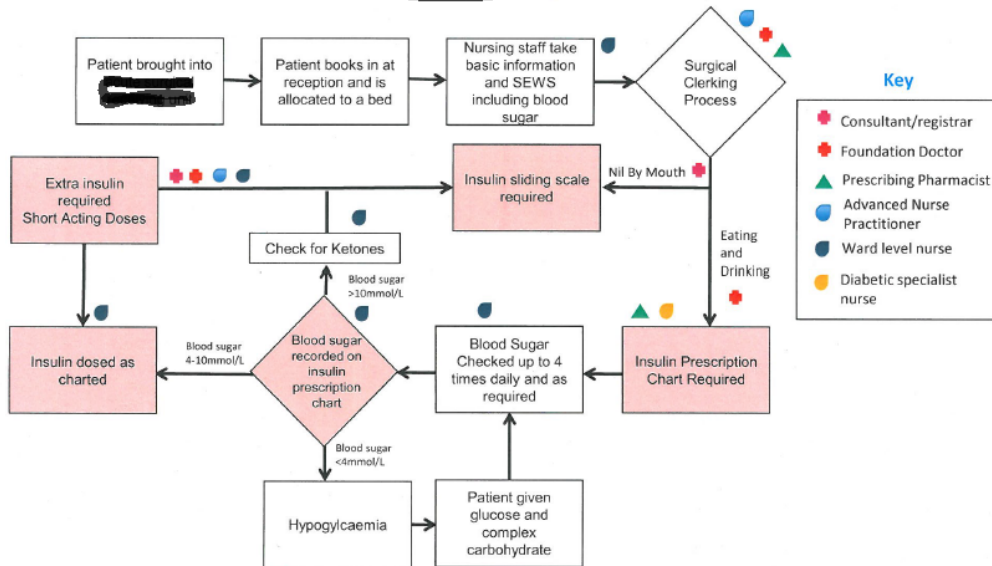
#### Do

**Describe what actually happened when you ran the test**

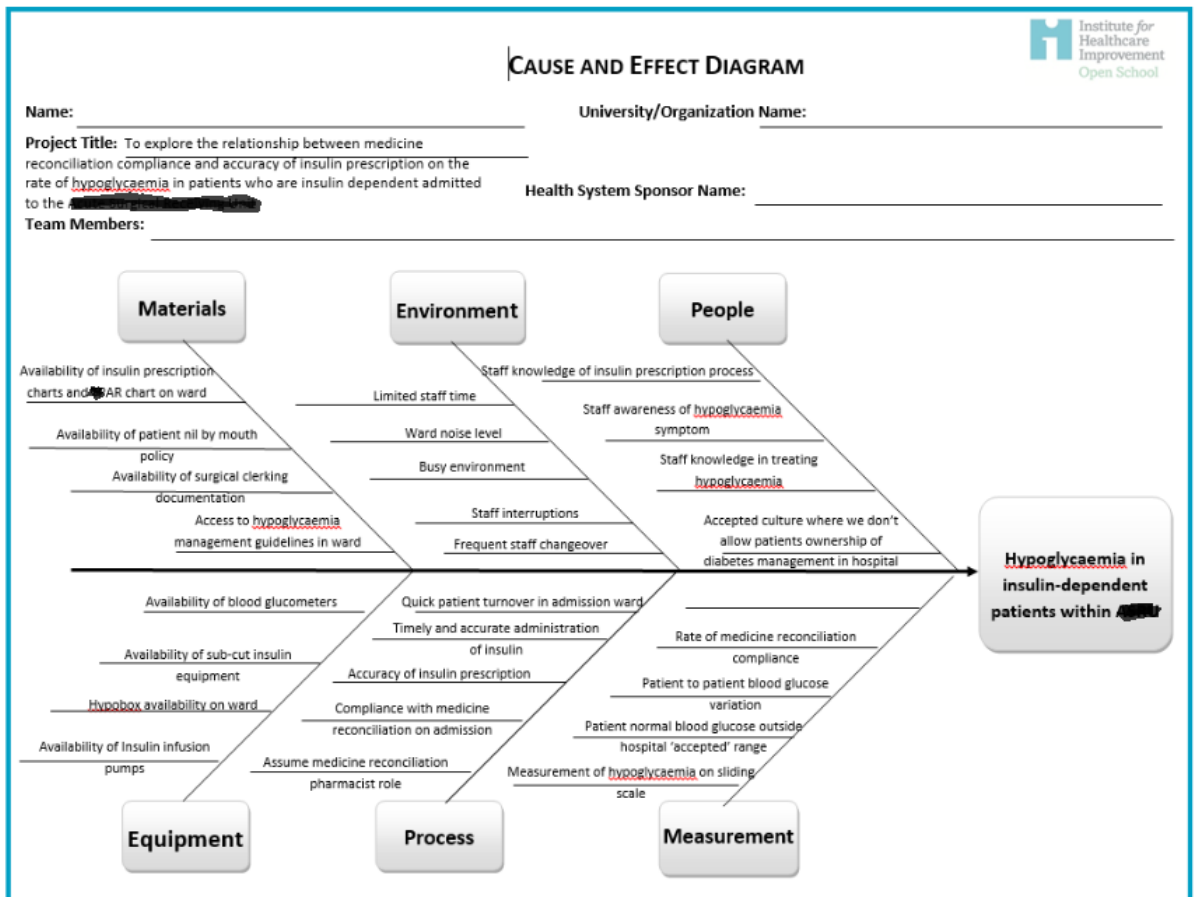
- We explained to the clinicians at [REDACTED] that we're going to obtain a simulation test and asked them to fill in the stickers while admitting [REDACTED] (who was pretending to be an insulin-dependent patient).
- Collected their feedback on a pre-designed feedback form.

As well as testing change, the students were required to complete a process map to illustrate the existing procedures that they were aiming to improve:

### Admission Process for Insulin Dependent Patients on [redacted]



The students also completed a template for a 'cause and effect' diagram to highlight some of the potential issues with the project and to identify 'balancing measures':





## Appendix 4: Annotated notes

Complete Book 2.pdf - Adobe Acrobat Reader DC  
 File Edit View Window Help

Home Tools Complete Book 2.pdf x 16 / 116

Comment

Sign In

*SEMS draft is A3.*

The rails on some walls have to go on the rail, but, rounded corners.

*Good example of why always the clipboard are left always the answer! Not big enough or easy to handle.*

Clip on back of clipboard to go on the rail, but, there is a hole screwed into the wall, possibly from an earlier system

*24/9* date format confusing in duration box (usually as 1/7 (week))

*2/5/2*

Gent chest has red, pink & brown boxes

An 'X' against box in steel on initial - so not sure if decided what to do.

Search Comments...

110 Comments

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so used to doing it this way, I don't want to change it. So it's kind of, you kind of need that communication. So, though, they feel that why you're doing it is important, so that they're willing, so teamwork's really important in that way, as well. But yeah... I think that it's one of they things that you kind of need to sense when you go onto an environment that you don't know what the dynamics are going to be, and the change, throughout different... And I think the number of different people change on each ward as well; so sometimes you've got lots of medics, and sometimes there's maybe two on a ward and it's mainly run by nurses. I was recently on a ward where there was a meeting every day at 11 o'clock to discuss all the patients, but it wasn't just the kind of medic ward round with a couple of nurses; it was all the nurses that could make it; the medics, the consultants, the OTs, the dieticians, the PTs, just so that they could discuss all the things relevant to that patient.

I: Right.

S1: And that's the only ward I've ever seen do that; normally, you know, the OT will come and visit the ward and someone will say, oh, you need to go see this patient or that patient. But there was never something as organised as that. So it was quite surprising. So we're hoping to kind of, maybe look at something like that for the project I'm doing.

I: Oh, OK.

S1: I think that would be quite useful. But again it's the dynamics, that ward obviously had that built in. But it will be interesting to see how it got built in. 'Cause I suppose if we tell someone: oh, you need to be here every day at eleven o'clock, they might think, well, I've got other things to do. Like.

I: Yeah.

S1: So I don't think there's enough staff to do that with every ward. So it would depend, I suppose, if they needed it. I think the ward I was in had quite a lot of elderly people that needed quite a lot of kind of social work help and stuff like that. So I suppose it suited that ward. So it... yeah, kind of changes in different paces!

I: So, regarding like, you mentioned the Ward Clerk earlier on, and how they told you where the notes were for patients and things like that. What kind of, what kind of things happen on a ward with paperwork and things like that; do you have iPads? Or... clipboards? Or...

S1: There's folders. So there's the kind of hard copies of notes. So they'll have, some patients have two or three big, thick folders.

I: Oh right.

**Bethan Mitchell**  
Importance of teamwork

**Bethan Mitchell**  
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Going into an environm

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Surprise at lack of organ

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Team dynamics and per

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Different ward, differen

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Paperwork

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