

## **Vulnerability in Critical Care Medicine: A Matter of Tight-rope Walking**

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Chapter for: *The Vulnerability of Technological Culture*.  
Part 1: *Framing the vulnerability issue*

### **Introduction**

As human beings we are vulnerable. Simply by virtue of our being alive, we are exposed to all sorts of threats and adverse influences, and each day we run the risk of getting seriously injured or ill, if not worse. Critical care practices such as the Emergency Department (ED), the operating room (OR) and the Intensive Care Units (ICU) are places where this vulnerability is revealed most vividly. It is here where our helplessness comes to the fore and our ability to control our world breaks down. At the same time, these places should be viewed as strongholds against our finitude and fragility. In these zones of protection clinicians do everything in their power to prevent further harm and help patients to cope with their own vulnerability.

The notion of 'vulnerability' is widely used in health care literature and practices, those of nursing in particular. Etymologically, 'vulnerability' comes from the Latin word for 'wound' (*vulnus*) or 'to wound' (*vulnare*). Its common usage still refers to this meaning: the word is commonly interpreted as being susceptible to harm, being liable to damage or harm, being at risk, or as referring to dependency, fragility, insecurity, or low resilience (Levine 2004; Rogers 1997; Spiers 2000). In most cases vulnerability is about being 'at risk' of poor physical, mental and/or social health (Leffers 2004; Levine 2004; Rogers, 1997). The concept is not only applicable to fragile newborn babies or ill individuals, but it is also used in relation to specific groups and populations, such as immigrants and refugees, people with AIDS, frail elderly people, ethnic minorities, the chronically ill and disabled, abusing families, and homeless people (Lessick et al. 1992; Levine 2004; Rogers 1997; Spiers 2000; Vladeck 2007). Members of these groups carry a higher probability of becoming ill. They are vulnerable in relation to their health status, access to health care, or the quality of health care. The health status of these groups can be labelled as 'vulnerable' for a variety of reasons, such as low income, poor education, being uninsured, belonging to a particular ethnicity or age group, or their having contracted a specific disease such as coronary disease (Vladeck, 2007). Some of these reasons are non-modifiable, such as genetic predisposition, age, gender, and ethnic status.<sup>1</sup> But in addition to constitutional factors, vulnerability may pertain to acquired components as well. For example, the level of vulnerability may be affected by perinatal complications or traumas (Rose & Killien 1983), a situational condition such as being homeless, or a specific environmental condition such as pollution and noise.<sup>2</sup> In general, being vulnerable has implications for the physiological, psychological, and social condition of individuals (Rogers 1997). Physiological effects

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<sup>1</sup> For example, just being an African-American woman increases the risk of having a child with a low birth weight (Vladeck, 2007).

<sup>2</sup> Some distinguish between the external dimensions of vulnerability (such as environmental risks) and its individual dimensions (cited in Levine 2004).

are, for example, the release of cortisone, the shutdown of the digestive tract, chronic fatigue, weight loss, depression, and insomnia. Psychological effects may include feelings of helplessness and hopelessness, fear, uncertainty, inability to concentrate, or emotional instability, while examples of social effects are stigmatization, alienation, and social isolation.

This chapter explores the issue of vulnerability in critical care practices. Critical care unit can be considered as contact zones of hi-tech medicine and exceptionally vulnerable human beings. As such these places involve a host of activities that are embedded in tightly-knot infrastructures. Many of these activities require a high level of specialisation. As a consequence of the real-time nature of the work, events must be managed while evolving; once a particular procedure is initiated, it cannot simply be stopped. This creates a strong sense of urgency and pressure of time. Since errors may lead to unacceptable and irreversible consequences, these environments involve risky practices, which call for a maximal level of reliability. In this chapter, these complex technological practices will serve as context for studying vulnerability in the domain of health care. Through its focus on clinical work, the argument in this chapter will elaborate the complicated interplay of problems and dilemmas associated with vulnerable patient populations in a complex technological setting such as a critical care unit. In this analysis, the various day-to-day operations in such a unit are not merely reflective of the busy work of doctors and nurses. On the contrary, by concentrating on actual practices, the diverse nature of vulnerability comes to the fore as a disposition of the patient population, as part of complex intervention systems, the organizational arrangements of the practice and with respect to the delicate relationship between these factors in particular.

The Neonatal Intensive Care Unit (NICU) will serve as an exemplary case for studying vulnerability. Over the past decades the NICU has constituted a domain where challenges and opportunities of new medical knowledge and technology converge. It is here that we can study some of the concrete vulnerabilities in the health care system triggered by this permanent dynamic of change. The data for this chapter was collected during ethnographic research in a Dutch and American Neonatology ward.<sup>3</sup> For the purpose of anonymity they will be referred to as 'Medical Centre' and 'General Hospital' respectively. Experiences as ethnographer on an Australian Emergency ward are used as well.

This chapter aims to provide an illustration of the multiple orders of vulnerability and their implications for the practical order of the NICU. Different forms of vulnerability will be studied at the level of the involved actors, their planned and unplanned actions, and the tightly-knit organizational arrangements respectively. However, in health care practice these different levels of attention are not separated, but interact. This dynamic contributes in its own way to the level and locus of vulnerability. In NICU practice different kind of vulnerabilities co-exist, interact, and in some cases compete. This chapter will illustrate how, when and where these vulnerabilities complicate the treatment trajectory in different ways and for different reasons. However, as being argued in the introduction of this volume, vulnerability has a flipside: it can be considered as something positive as well. Also in the NICU context vulnerability is not, as I will show, only considered as something negative. Here too it is sometimes regarded as the cause of strength, growth, and awareness. Additionally, as this chapter will show, some of the measures to cope with

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<sup>3</sup> The ethnographic data is based on my fieldwork that has been carried out in the nineties (see Mesman 2008) and over the last three years (2006-08).

vulnerability in the NICU will actually diminish the level of patient safety. To study the vulnerability of a health care practice like a NICU I will first focus on the people who use this high-tech care setting to live, love and work. In the second section, I shift the focus to the delicate balance of the intervention process. In the third section, the vulnerabilities of the health care organization will be discussed. Some conclusive remarks will be presented at the very end.

## 1. Vulnerable patients, parents and practitioners

### *Medical Centre:*

In the corner of the NICU, Julian, a premature baby, unexpectedly enters in a serious crisis. The doctor is called in right away. The baby looks terribly pale. The monitor indicates some serious trouble. Until now Julian was doing so well that this morning his oxygen tube was removed and he switched to a non-invasive form of respiration. Although all day Julian continued to have good blood gas values, now he no longer seems able to cope.

The neonatology ward specializes in the care and treatment of newborns. Newborn babies are here because their lives are seriously at risk on account of complications linked to their delivery, congenital diseases, infections, food intolerance, or premature birth.<sup>4</sup> The children on this unit are in a life-threatening condition and need special care. Take, for instance, a prematurely born baby like Julian. As a rule, children born after a term of less than 32 weeks or with a birth weight under 1000 grams are always admitted to this ward. The vital functions of premature infants are quite unstable and insufficiently developed. Premature children lack the capability to self-regulate their body systems properly. Their lungs, for example, are too immature to provide for the full amount of oxygen required for survival. In these cases, withholding treatment means instantaneous death. If the staff does opt for intervention, they will immediately connect the baby to the ventilator for oxygen supply. The circulatory system also develops problems due to immaturity. The fragility of the blood vessels, in combination with irregular blood pressure, may cause the vessels to be ruptured, while high blood pressure can lead to severe brain damage. And there are many more potential problems: a delicate fluid balance due to a thin skin can bring a premie into a state of supercooling and dehydration; kidneys often have trouble functioning; and the infant may simply 'forget' to breathe because of the immaturity of its respiratory mechanism in the brain. In response to this, the heart rate can drop rapidly. An infant's condition may be so unstable that it cannot be touched at all. When such vulnerable condition requires a 'hands-off' policy, providing care has entirely become a technological affair. The baby is only touched, so to speak, by the tubes of the many machines to which it is connected, functioning as a material passageway.

From the outset, children on the NICU fully depend on medical technology. Lined up side-by-side, their incubators are hooked up to an array of state-of-the-art medical

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<sup>4</sup> The treatment of critically-ill newborns often gives rise to moral dilemmas. See, for example, Anspach (1993), Frohock (1986), Guillemin & Holmstrom (1986), Lantos and Meadow (2006), and Mesman (2008). All these studies are based on participant observation. Although highly important, the issue of moral dilemmas is not the focus of this chapter.

technologies. After several days or weeks of treatment, most of them will manage to cope without all the technology and they will have turned into the baby their parents had hoped for after all – one they can touch and hold and hug. However, before getting there is usually a long way to go. This trajectory does not only affect the patients, but also the involved parents and staff. Therefore, I will not only focus on the fragility of NICU-babies, but will also describe how parents and caregivers are vulnerable in their own way. Additionally, I explain the different perspectives on vulnerability as we can find them in different sections of health care literature.

### *Vulnerable parents*

Newborns are fragile and vulnerable, but in the NICU context they are not the only ones thus considered. A child's hospitalization usually disturbs the natural bonding between parent and child. The course of its treatment is highly unpredictable, and therefore it is only natural for parents to fear a bad outcome. This fear may prevent them from bonding with their child. Because parents are separated from their child and did not get the healthy baby they hoped for, they suffer in fact a double loss. This triggers a mourning process that may include a variety of reactions including anger, disbelief, panic, emotional withdrawal, and resignation. As a result the NICU staff often refers to parents and children as constituting a single unit of care. Parents have a psychosocial problem, rather than a medical one, and this problem calls for a psychosocial approach; or, put differently, they are considered 'second-order patients,' so to speak (Guillemin & Holmstrom 1986). Apart from treating newborns, providing support to parents plays a major role in a NICU. Nurses in particular are in charge of giving this support, and their specific discourse on parents contributes to structuring the unit's social order. They inform them about their child's treatment, show them around the NICU, tell them in everyday language about the child's condition, and function as their help and stay. If physicians have authority over a child's condition, nurses are in charge of dealing with the parents. In this respect, nurses act as 'emotional managers' who evaluate and manage parents' attachment to their baby (Anspach, 1993, p.144).

Moreover, parents and staff need each other in their care and concern for the child. Sharing the same objective, though, does not guarantee a smooth collaboration. Parents with their individual hopes, histories and expectations and staff members with their various specific rules and rituals meet each other around the incubator. All sorts of tensions may drive a wedge between staff and parents. Various factors thus provide a breeding ground for unjustified expectations and a perplexed, annoyed, or outraged response. In the worst case there is a fundamental breach of confidence. However, it is in everyone's best interest, in particular that of the child, that they do not turn themselves against each other.

A baby's discharge from hospital however, does not automatically resolve the problems involved. For one thing, many parents of NICU babies continue to perceive their child as medically vulnerable and act accordingly. Several studies show how a high maternal perception of child vulnerability leads to disproportionately high health care utilization, and more important, it also correlates with a worse developmental outcome (Allen et al. 2004; Eiser et al. 2005; Thomasgaard 1998). Parents who nearly lost their child tend to shelter it inordinately; they are alert and take its vulnerability into account with everything they do and plan. But at the same time they should provide opportunities for their child to experience normal challenges to develop a certain degree of independence (Eiser et al. 2005). If former NICU patients have less opportunity to grow on their own, high maternal anxiety also affects the

parents. Caring for vulnerable children is considered more stressful. Allen et al. (2004) describe how mothers who perceive their child as vulnerable felt more anxiety and were more depressed, while also they were less optimistic, experienced less satisfaction, and received less social support (271). In other words, vulnerable babies produce vulnerable parents who will raise 'vulnerable children'.

### *Resources*

It would be wrong, however, to situate only the origins of vulnerability in either the individual involved – be it a newborn or a parent – or their immediate living environment. The resources for dealing adequately with these health-threatening factors may equally be found in the individuals involved or their environment. Inborn characteristics, like temperament, and acquired characteristics, such as life experience and coping skills, affect the ability to respond to stress (Rogers 1997). For example, in the NICU some children are specifically referred to as 'fighters'. As one nurse in the General Hospital explains:

"Some of the children in this unit do survive against all odds. Their will to survive is so strong. Some of them had to fight for their life already during pregnancy. If you look at their faces you can see how they have struggled. But they know how to fight and have better chances to survive than those who run into problems after the delivery. In some hospitals they first do a 'survival test'. After a baby is born he has to prove for some hours how strong he is. We don't do that in this hospital, because the sooner you act the more opportunities you have. If you decide to act afterward, you already lost out on several specific opportunities. The sooner you address a problem the better."

Newborns find themselves in one of their most vulnerable stages of life, and NICU infants are at risk by definition. Constant monitoring and careful medical treatment are literally of vital importance to them because typically their condition is subject to strong fluctuations. This variability requires around-the-clock monitoring and frequent adjustments, while an admitted child's recovery should never be taken for granted. In the efforts geared towards facilitating the recovery process, nurses play a crucial role.<sup>5</sup> Aside from the child's individual characteristics, maximal support from his environment may help him to improve his condition. As such, individual vulnerability is never a static state. Persons are more or less resilient or vulnerable to particular risks at different stages of life and during transitions in particular. Although the amount and diversity of support may be substantial, in some cases it may not meet the child's need, causing the stress to exceed the 'threshold of vulnerability' (Lessick et al. 1992).

A child's vulnerability should not only be considered as a negative feature, however. According to one of the hospital hygienists in the General Hospital, it also contributes to the level of patient safety:

"It is the vulnerability of the baby's body that triggers a high level of vigilance. When you take care of a patient who is as fragile as a NICU-baby, it implies that you cannot afford any mistakes. You have to be very careful in

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<sup>5</sup> Lessick et al. (1992) proposes a 'vulnerability model' as a framework for nursing practice. This model should assist nurses to understand individual-environment relationships.

everything you do. The staff on this ward is fully aware of the vulnerability of their patient population and that keeps them highly alert. It is a specific safety culture that is prompted by the fragility of the babies they take care of. The vulnerability of NICU babies is appealing to the staff's responsibilities, so to speak. Besides, the parents sit next to their baby's bed all day and keep an eye on everything that is done."

### *Perspectives on vulnerability*

So far the conceptualisation of vulnerability has largely been based on epidemiological principles and a biomedical view of pathology and illness and it basically reflects an external (etic) perspective (Lessick et al 1992; Spiers 2000). In this public health model vulnerability is the universally present relative risk of potential or actual harm. However, an internal (emic) perspective is possible as well (Leffers et al 2004; Malone, 2000; Rogers, 1997; Spiers 2000). In this perspective vulnerability, as based on the individual experience of exposure to harm, is framed within a psycho-social-cultural context. Vulnerability is considered as something we all experience in daily life every now and then. Significantly, proponents of this perspective emphasize the potential positive assets of vulnerability (Leffers et al. 2004; Malterud & Solvang 2005; Spiers 2000). According to these authors we should give more attention to the strength of what is assumed to be a weakness. Vulnerability, they argue, can be regarded as a potential for personal growth because it is a challenge that requires a response.

Vulnerability is a widely used concept in today's health care, and the divergent perspectives on it contribute to a lively discussion about the use and meaning of the concept (e.g. Hurst, 2008; Mechanic & Tanner, 2007, Vladeck, 2007). Levine (2004) describes how various health care domains focus on different aspects of vulnerability. Biomedical research, for example, emphasizes the limitations of an individual's or community's decision-making capacity, while in social science research the focus is on persons or groups who in fact have such capacity but miss the power or resources to use it (p. 397). In bioethical research vulnerability is not just about the risk of being harmed but also about the risk of being wronged. When trying to define who is actually vulnerable of what, one runs into all kind of problems. Defining vulnerability as a universal expression of the human condition means that it encompasses each and every individual. But what is the value of such a broad, all-inclusive scope? In its most restricted form, as in ethical conduct of research with human subjects, one runs the risk of excluding participants of clinical trials who need protection as well.<sup>6</sup> According to Hurst (2008), the concept of vulnerability can be both too broad and too narrow when applied to the ethics of clinical research. The same counts for its usage in the ethics of health care, which involves such issues as adequate financial coverage, access to healthcare, not being harmed, confidentiality, and self-determination.<sup>7</sup> Due to these kinds of difficulties the use of vulnerability as a concept is criticized for having lost its analytical and practical value. Moreover, categorizing specific groups as vulnerable can have a stigmatizing effect, as if these groups are not capable of decision-making (Hurst 2008; Levine 2004; Vladeck 2007).

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<sup>6</sup> To solve this problem in research ethics, Hurst (2008) proposes to start from the sorts of wrongs likely to occur, instead of defining the vulnerable persons and populations. So, while designing our research protocols we should define 'vulnerability as an identifiably increased likelihood of incurring additional or greater wrong' (p. 5).

<sup>7</sup> See also Levine 2004.

### *Frequent flyers and Fellow-Feelings*

While scholars in nursing and health sciences are debating the best definition of 'vulnerability', the staff members of critical care units actually have to deal with specific vulnerabilities on a daily basis. On the one hand they are confronted with the fragility of their patients who are highly susceptible to harmful events due to their frail condition. On the other hand, they acknowledge that vulnerability is a common condition of all humans, including themselves.<sup>8</sup> While witnessing the helplessness and suffering of others, they have to come to terms with their own vulnerability. Also Emergency ward clinicians are constantly confronted with the vulnerability of the human body and the finitude of human life.<sup>9</sup> Specific characteristics of the Emergency Department (ED), such as the high turn-over of patients and the climate of urgency, help to shield clinicians from confronting this existential vulnerability. But this walling-off becomes more difficult in the case of 'frequent flyers' (Malone 2000, p. 3). Taking care of regular visitors of critical care settings involves another level of engagement and this creates a field of tension. According to Malone (2000) the familiarity with patients challenges the protective layer and makes it harder to just do what needs to be done and ignore one's own existential vulnerability. Malone describes how ED nurses use myth making and explicit distancing as a coping mechanism in these kinds of cases. For instance, the myth-making excludes these patients from the domain of 'ordinary people'. In these stories these ED patients have the ability to defy death and have the power to save their own body. According to Malone, ED staff finds comfort in the myth of the 'frequent flyer as superhuman, since it shields them from a shared vulnerability.

However, according to some nursing experts, the recognition of one's own fragility should also be considered as a positive that should not be avoided (Daniel 1998; Malone 2000; Spiers 2000). Mutual vulnerability, they argue, generates compassionate engagement with a patient and contributes to bonding between nurse and patient. Daniel (1998) argues that the acknowledgement of a shared vulnerability is the key to authenticity. Acknowledging one's own vulnerability provides access to understanding a patients' experience. According to Daniel, nurses should take the opportunity to participate in vulnerability, rather than avoid or protect themselves against it. As such, it is a vehicle for practicing authentic nursing and a way to celebrate humanness (p. 191). Thus vulnerability can result in a rich engagement with the patient (bond) or a walling-off (barrier), while sometimes a little of both is involved. This in turn requires careful balancing between engagement and dissociation. On a NICU this is easier said than done. Because nurses spend much time with the children, they gain much specific knowledge about them. Their work also tends to foster a more personal contact with the parents involved. This puts the nurses in a vulnerable position: the stronger the bond, the bigger the loss when the baby dies or is discharged and goes home. As one of the nurses in the Medical Centre points out:

'You try hard to provide the best possible care to the child. Because you are constantly caring for the same child you know well how he is doing. No one else

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<sup>8</sup> Spiers (2000) recognizes these two different approaches in nursing. Vulnerability as an externally evaluated risk is an etic view, while from an emic angle vulnerability is a state of being (p. 716). In most literature the etic view prevails.

<sup>9</sup> This form of vulnerability resembles the European 'principle of vulnerability' (Hurst, 2008).

follows his medical course as closely. But you also learn to know the child very well in terms of what he likes or dislikes. Of course you grow attached. It's almost like he is one of your own children. And you also become involved with the parents, for you see them almost every day as well. There is a constant balancing between emotional bonding and knowing that one day he will go home, at least, if all goes well.'

Nursing care implies emotional involvement. In some hospitals staff members deal with this through the organization of their work and try to strike a balance between continuity and rotation of shifts. For example, nurses may provide care to the same child for three or four days in a row, but not weeks in a row. This policy is meant to prevent them from becoming emotionally overburdened. This contrasts with hospitals where nurses work on the basis of primary nursing, meaning that one nurse is primarily responsible for the care of a child during its entire admission. The downside of this hospital's mode of organization is that nurses may become too emotionally involved with a child, especially when their stay in the NICU lasts several months. In such cases the emotional bonding process may cause nurses to identify with the parents.<sup>10</sup> Take, for example, one of the nurses in the Medical Centre who has been in charge of a baby who has been in the NICU for six months already and fully depends on artificial respiration. Like the parents, this nurse believes that one day the baby will be able to go home. Although her colleagues do not share this prognosis, they understand her position, for they know that caring for a chronic child frequently leads to a high level of attachment. The members of the nursing staff are aware of how such processes work and they are trying to support their colleague. This, however, is not an easy task as one of them explains:

'It is obvious that she is denying the hopeless situation. But we have all been in charge of caring for a chronic child and we know what it means. You do not see how attached you have grown to a child when you are still fully engaged in providing care. Only when it is too late you realize how much you bonded. It is as if the child is your own baby. As if your own baby is slowly dying there. I was once in that position myself. I too couldn't accept it either when someone else cared for him because I was off duty or working in another unit. That caused enormous strain. Now she finds herself in such situation. Her life is now turning around this baby. We have tried to make her keep more of a distance by having her care for another child. But this is precisely what she does not want to do, for only she can care well for him, she feels. This is why we let her go ahead and support her as much as possible. But later on, when eventually the child will die, she'll need us the most. For then she is done up with emotion. Some of us try to help her by telling her to anticipate that things may go wrong. But she does not feel helped by this at all. She knows the risk is there, but no one has to tell her.'

Although the system of primary nursing assumes the nursing staff to have good insight into a child's condition, it turns out that keeping some emotional distance is important as well. According to her colleagues this nurse bonded too much with the child, and this clouded her professional gaze. In this respect it is important to note that a strong emotional engagement does not always distort prognostic judgment,

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<sup>10</sup> See the study by Anspach and Beeson (2001) on the relationship between emotions and morality for a detailed analysis of how different levels of emotional engagement are shaped by institutional arrangements.

for it may also cause staff to understand families' suffering (Benner, Tanner and Chesla, 1996). Nor is emotional detachment always a virtue, given that it can blind people's awareness of suffering and lead to needlessly aggressive medical interventions. Therefore, neonatal nurses must come to terms with the combination of attachment and inevitable loss. Savage and Conrad (1992) refer to this vulnerability of the neonatal nurse as the likelihood to get 'wounded'. They discuss the work of Gadow who proposes the strategy of 'fellow-feeling' to prevent too close identification. Nurses should find a degree of emotional involvement in which they visualize the patient's or parent's emotion – like joy or suffering – while making sure not to experience it in the same way as they do. This 'fellow-feeling' prevents 'infectious identification' (p. 65).

Infectious identification, immature lungs, and maternal anxiety: vulnerabilities of all kind inhabit the NICU practice. However, the management of the fragile condition of the NICU babies is core business in this health care practice. However, the NICU caters to children whose clinical picture is erratic and complex. Their development is rather marked by ups and downs than by straightforward progress. All in all, treatment of these patients is, as will be described in the next section, not an easy task and involves a delicate balance.

## **2 Medical actions and the balance between efficacy and safety**

The basic task of the NICU staff is to respond adequately to the frequently changing conditions of its patients. These changes are not always predictable and seldom unambiguous. Like all infants, the children on the NICU go on growing after birth, and this is of course an essential development. If, however, an infant is too small or too ill to realize this natural growth on its own, its condition will worsen without outside intervention. In such cases change implies no longer growth or development but a deadly threat, and direct intervention is essential. Furthermore, changes may be the effect of treatment and often this will mean recovery. By the same token, not all children in this unit respond to treatment according to the handbooks, while factual data on their conditions are ambiguous or not available yet. This is why NICU efforts also have a more experimental basis: they rather involve attempts to influence the course of events so that a child's condition will improve. Even if much of this work is routine and experienced staff will not be caught by surprises easily, it is also common that situations recur in which indecision prevails. Considering the list of possible dangers NICU patients must cope with, their treatment resembles tightrope-walking. A small change in their health status can have dramatic consequences. On a NICU a treatment trajectory is characterized by an intrinsic tension between the need for intervention and making adjustments, demanded by the vulnerability of the newborn, on the one hand and the associated risks and uncertainties involved in the application of medical technologies and medication. This dilemma implies that while working on the improvement of the bodily functions of the baby, trouble may be hiding in the every corner of the treatment trajectory. In a critical care environment such as a NICU, with an exceedingly vulnerable patient population, this applies to almost every act and decision. After all, in this delicate environment, all that is happening, or being done and decided (or, for that matter, *not* done or decided) has the potential of turning into a problem. This section will describe medical actions, notably air and food supply, in more detail to illuminate the convergence of complications and the fine-tuning of action and re-actions to manage

these problems. By unfolding these situations I will demonstrate how different vulnerabilities co-exist, compete and are combined

### *The mixed blessing of medical science and technology*

#### *General Hospital:*

Sounds of alarm signals pervade the NICU space, parents sit next to the incubator of their child, and nurses and doctors exchange entirely unfamiliar words. The phone rings. The nurse nods and informs the attending doctor: the expected admission is coming up from the delivery department. Soon a baby girl arrives in a transport incubator flanked by a nurse and a resident. The baby is born prematurely at twenty-six weeks' gestation and immediate action is required. Within a few minutes she is installed and several lines and tubes go in and out the incubator and connect her body to a set of machines that surround her bed. The electrodes on her body provide the staff with nonstop information on the monitor about her vital functions like heart rate, blood pressure, respiratory rate, saturation, and temperature. The tube in her throat is connected to the ventilator behind the incubator. The resident discusses the position of the ventilator with the attending neonatologist. The nurse makes the preparations necessary for the blood tests to be taken. Meanwhile, the resident orders an X-ray, so within a moment they can have a good look at the baby's lungs and check if the tube of the ventilator is in the right position. The nurse makes sure the baby is comfortable because she looks exhausted and the monitor displays a fickle picture.

This is how Bernice starts her life in the dynamic hospital context. All activity is geared toward stabilizing the baby as much and swiftly as possible. While tuning their activities they try to solve the problems they encounter. Given the extreme fragility of the patients treatment, therefore, is never merely a matter of solving an infant's medical problem. Instead, it always involves a delicate fine-tuning of actions and re-actions. This enables them to develop a constructive (medical) intervention.

Medical technology provides the staff with a major basis for treating and providing care to the children in the NICU. The respirator plays a central role in the treatment of NICU children, the premature ones in particular. The vital functions of premature infants like Bernice are quite unstable and insufficiently developed. As such, they lack the capability to self-regulate their body systems properly. Their lungs, for example, are too immature to provide for the full amount of oxygen required for survival and they will be connected to a ventilator for oxygen supply. The form of air supply frequently tells a lot about the child's condition. It is a positive sign when a child needs only minor support in this respect. In such case extra oxygen is inserted into the incubator via the circulation system. If this is not enough, the oxygen is inserted into the nose directly via a tube. When a child needs more support in breathing, the oxygen is brought into the lungs with the help of overpressure. This form of respiration still lets the child breathe on her own. But in extreme cases, when children are too small or ill to breathe on their own, they fully depend on the respirator. This device, which inserts a mixture of air and oxygen into the windpipe, allows one to regulate the insufflation pressure, its frequency, quantity, and oxygen concentration. Both the form of respiration and the device's settings are seen as yardsticks for a child's condition.

However, the use of a ventilator is not without hazard. Prolonged mechanical breathing with high oxygen concentrations or high air pressure might damage the eyes and the retina in particular, but can also cause infection or damage the fragile lungs of premature babies to such extent that it reduces the intake capacity to an unacceptable level (Latini et al 2003). In these cases it is hard – and sometimes even impossible – to wean down the machine’s input. Therefore the practice of having a child on artificial respiration implies that one constantly has to look for the right balance. It calls for a very precise registering and constant correcting of the direction in which the child is moving. Its correct usage involves more than just inserting the tube in the trachea and setting the device. It also requires a specific organization of the practice and the availability of specific knowledge and experience. To determine the optimal setting of the respirator, the saturation of the oxygen is determined. This is possible by means of an infra-red light, attached to the child’s hand or foot. The monitor above the incubator indicates the saturation level measured in percentages. However, regular relocation of this non-invasive device is required because the delicate skin of a premature can easily get burned. The saturation level can also be determined by taking a blood sample via a intravenous line in one of the (main) arteries and subsequent lab analysis. Based on the saturation the neonatologist determines the respirator’s setting. If a child’s respiratory rhythm does not run synchronously with that of the respirator, however, the oxygen supply is disturbed. Medication thus serves to suppress the child’s spontaneous breathing, so that he cannot start struggling with the respirator. This requires a careful balance to prevent the child becoming addictive or hypotensive. Moreover, a premature child is also administered medication to improve the ventilation function of the undeveloped lungs. With the help of X-rays and regular blood tests the staff monitors lung development. The single decision of putting a child on the respirator thus implies a number of as of yet undefined future decisions.

*General Hospital:*

Soon after the admission of Bernice the neonatologist prepares himself to insert a central catheter. He walks to the incubator, opens the little doors and switches on the light to have enough light to see the baby’s veins. He examines her legs and arms to find the best place to insert the line. After looking carefully while gently rubbing the baby’s skin, he opts for the brachial vein, the large vein that runs up from the arm to the shoulder. He takes a tape measure from the table next to the incubator to determine the length between the insertion site in the arm and the upper part of the shoulder where the superior vena cava, a large blood vessel that leads to the heart, is located. He estimates having to insert the line approximately 15 centimetres. While closing the incubator, he informs the nurse responsible for the baby about the location and size of the catheter. After switching off the light, the neonatologist walks up to the cabinet in the other corner of the NICU to take out a cap and a facemask, after which he heads for the sink to scrub in.

Very ill or premature newborns miss the strength to feed themselves. Therefore a small polyurethane tube is inserted into the baby’s bloodstream. This catheter provides access to the baby’s body to administer medication and parental nutrition. Central catheters are used when it is expected that the baby needs intravenous infusions for an extended period of time. In this way they can avoid the stress and discomfort of repeated needle sticks because these central catheter’s lines can stay in as long as four to eight weeks.

Although intravenous access is essential for optimal management of the vulnerable patient population one finds on the NICU, the deployment of this technique is not without risk. Intravenous access can cause infections, the so-called catheter-related bloodstream infections (CRBSIs). Vascular infections make up a huge part of the nosocomial, or hospital acquired, infections and contributes substantially to hospital morbidity and mortality rates. Estimations present figures of around 50,000 to 100,000 blood stream infections per year in the United States alone. Ninety percent of these infections are related to central venous catheters (Sheretz et al. 2000). In case of an infection the baby will be treated with antibiotics. Yet, this involves the risk of drug-resistance. In these cases the antibiotic does not work anymore because the bacteria can withstand the drug to which it was once receptive.

To prevent CRBSI, several strategies have been developed, ranging from finding the best insertion site, skin preparation with chlorhexidine, maintaining proper nurse staffing levels and the use of catheters with anti-infective coatings or antibiotic impregnated catheters to the use of maximal barrier precautions (MBP). The optimal safety strategy is to use all of these strategies (Rubinson and Diette, 2004). Whatever the strategy, the various preventive actions all aim to keep the germs out by working with sterile instruments in a sterile environment. Despite the precautionary measures, there is still the risk of a vascular infection. What is considered the 'right spot' for inserting the line, then, is based on a balancing between efficacy and safety. The neonatologist tries to find the place where he can insert the catheter into a vein wide enough for a central line, and low enough to leave the possibility open for a supplementary line if this one has to be taken out due to an infection. However, line-infection and drug resistance are not the only problems. Lines can get clogged. Anti-coagulation drugs have to prevent the line from becoming clogged. But in the case of premature babies, anti-coagulation increases the baby's chance to get a brain haemorrhage due to the vulnerability of their veins. A brain haemorrhage causes an increase of the pressure in their head, which requires a drain to discharge fluids. Also an internal drain can lead to complications. The fluid the infant is losing can cause a low blood pressure that is so substantial that the cranial sutures will fall over each other. Being aware of the infants' vulnerability and the unintended consequences of their own interventions, the staff attempts to keep close tabs on the vital signs in order to be in the best possible position to prevent disastrous outcomes. Therefore, the most accurate, up-to-the-minute information is required, often on an ongoing basis.

#### *Competing frames of vulnerability*

The more control, the better are the chances that a child will survive the incubation period without serious complications. This insight has always been an impetus for enhancing the sensitivity of equipment. The fragility of the NICU patients requires a fine-tuning of medical technology of at least two decimal places. The significance of highly precise adjustment of food and fluid intake, air supply and the administration of medication, is reflected in the development of NICU technology over the last two decades. This development can be characterized by a high level of improvement of already existing technologies. However, the staff is well aware that, no matter their hi-tech resources, at any time, without any warning, a child can suddenly collapse. Hence the intensive monitoring practices. Every irregularity, no matter how small, activates an alarm attached to the monitor. Elaborate monitoring rounds take place every other hour or less frequently. Depending on the instability of the child's condition, the frequency of the checks and rechecks is raised.

*Medical Center:*

10:00 hours: The nurse takes the flow sheet that is on top of the incubator of Bernice and observes her intensely. After some time he ticks several boxes on the paper. Next he writes down several various readings from the screen next to the previous data he entered three hours ago. With a stethoscope he listens to her heartbeat and counts her breathing. He judges her colour and enters his finding next to the other data. The intravenous systems are checked. One provides nutrition and two others medication. Their flow and dosage is regulated by a perfusor system. The readings are entered in the flowchart, as is the case with data on the ventilator's pressure and rates. He also takes a blood sample for analysis. In three hours the nurse will again check, measure, and record these same aspects and data.

A search for the right course of medical action requires the most up-to-date and detailed picture of the child's condition. However, even monitoring the child's condition is not without risk. For collecting all the relevant information they have to undergo a sheer endless series of interventions in the form of checks and tests. Many of the regular procedures are a burden to children. The daily checks and tests can lead to much discomfort. The intubation of the respirator tube, the clearing of the mouth cavity, and injections and punctures may even destabilize a child. All routine acts may cause stress in children. Painkillers and sedatives can only control this in part.<sup>11</sup> After some time a child will get sleeping problems, become restless, and cry a lot. To diminish the potential deteriorating effect of the interventions on the condition of the baby, the NICU staff make every effort to lower the burden and increase the sensitivity of monitoring and therapeutic devices. However, the result of having these resources is an elevation of the level of environmental noise. Environment factors, such as light, noise, cold and heat, can also be bothersome for a child. Especially glaring light and noise are a source of stress. Although the level is still moderate, the continuous sound of the technical devices surrounding and penetrating the incubator may cause hearing impairment and abnormal stress responses and sleep patterns (Berens 1999). The light, noise and daily series of interventions lead to a raised heart beat and breathing frequency and a lowering of the saturations (Allen, 1995; Zahr & Balian, 1995). In particular chronic children have so many negative experiences that they respond in a stressed way to each stimulus, which makes it hard to provide care.

A closer look at the food intake and air supply in NICU practice reveals how different kind of vulnerabilities co-exist: brittle veins and bacteria receptive intravenous lines, fragile lungs and sensitive eyes, instable conditions and vulnerable skins. The staff has to find the delicate balance between adequate treatment and iatrogenic consequences. However, this is easier said than done. How to decide which vulnerability should be the indicative factor? For instance, some nurses consider a restricted feeding policy more appropriate as it avoids the risk of necrotizing enterocolitis (NEC) in which case portions of the bowel undergo tissue death due to infection. The medical team claims, by contrast, that an increasing caloric intake will make the baby grow and as such more resistant to infections. In this case the

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<sup>11</sup> Not so long ago the prevailing view was that newborns – premature babies in particular – would have no experience of pain. This view has been left behind for years and pain in neonates now counts as a major field of research. See Bours et al. (1997).

vulnerability of the premature baby's condition competes with the vulnerability of the bowels.

In sum, treatment trajectories in the NICU are the outcome of a delicate interplay of multiple actors and factors, including a child's responses to them. The treatment of the NICU-babies shows how side-effects of interventions can develop into substantial problems. As problems are accumulating, it becomes ever harder to keep a child on track and the staff constantly has to map out new routes. When complications occur, new treatment protocols are added to the trajectory. This causes a condensation of the number of treatment lines that converge in the child. Each new intervention needs to be given a place in a growing system of interactions, but this is not always easy, nor does it keep other treatment options open. What to do with respiration pressure or medication that cannot be gradually reduced? The malleability of the treatment trajectory is limited by natural and technological boundaries. A respirator with high pressure, side-effects of medication, bacteria, fragile tissue – all these may be encountered along the way. A difficult case demands constant adjustments and involves much more than just guiding a child along a well-paved path. One gridlock after the other may present itself. Unintended effects on other medication or physical processes may give rise to new problems that call for new interventions. A 'locomotive phenomenon' comes into being, whereby one intervention elicits another (Guillemin and Holmstrom, 1986, p.131). In some cases the pattern of interventions loses its coherence while the initial goal – the child's full recovery – has to be adjusted to 'second best'. In situations like these, the staff runs up against the boundaries of the NICU practice and it is reminded that eventually its mother's womb is the best place for a child to spend the first nine months.

### **3 The Brittleness of Reliable Arrangements**

To deal with the vulnerability of their patient population and the delicate safety-efficacy balance, practitioners follow protocols and implement flexible adaptations when needed. As such life in the critical care unit is determined by an ongoing flow of activities associated with highly specialized care providing, the admission of new patients (including their family), as well as by the fluctuations in the conditions of the patients. NICU practices can be considered 'high-3 work environments': high-technology, high-intensity and high-reliability.<sup>12</sup> High-3 practices are characterized by time-pressure and specialised practitioners. They are complex systems with tightly-knot infrastructures. As a consequence of the real-time nature of the work, events must be managed while evolving. Once a procedure is initiated, it cannot be stopped. Considering the vulnerability of their patient population errors and mistakes may lead to unacceptable and irreversible consequences. This creates a strong sense of urgency and time-pressure. These risky practices call for a maximal degree of reliability. However, their high level of interdependency and interrelations turn these complex socio-technical practices into quite vulnerable systems.<sup>13</sup>

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<sup>12</sup> High-3 work environments can also be found in, for instance, the aviation industry, the chemical industry and nuclear power plants. What they all have in common is the potential of major incidents with drastic consequences on an everyday basis.

<sup>13</sup> The way I refer to the vulnerability of the health care system, should not be confused with the 'vulnerable system syndrome' as developed by James Reason (2001), which refers to a specific cluster of 'organisational pathologies'.

This high level of complexity complicates the work and gives rise to errors and mistakes. Several studies – such as those of the Institute of Medicine in the United States (Kohn 2000) and the Department of Health in Britain (2000) – have shown an unacceptable high level of adverse events and near-misses. The report of the American Committee on Quality of Health Care of the Institute of Medicine (IOM), entitled *To Err is Human* (2000), estimated that each year over one million patients are involved in adverse events, of which almost a hundred thousand are lethal.<sup>14</sup> Adverse events are defined as injuries 'caused by medical management rather than the underlying condition of the patient' (p. 28). Examples of adverse events are transfusion errors, adverse drug events, wrong-site surgery, restraint-related injuries or deaths, preventable suicides, burns, falls or treatment-related infections. The IOM report defines error as 'the failure of a planned action to be completed as intended or the use of a wrong plan to achieve an aim' (p. 4). Not surprisingly, a high error rate of adverse events with serious irreversible consequences is found in particular in intensive care units, emergency departments, and surgical units.

The publication of *To Err is Human* gave rise to serious concerns in and outside the United States about the level of patient safety.<sup>15</sup> Since then attitudes towards patient safety have changed (Leape and Berwick 2005). Today patient safety is high on the policy agenda of many countries, while a multitude of governmental and non-governmental organizations are involved in the enhancement of patient safety.<sup>16</sup> Based on organizational theories, notable High reliability Theory (e.g. (La Porte and Consolini, 1991) and James Reason's 'Swiss Cheese Model' (1993, 2000), they all try to initiate various changes in the organizational arrangement in which the treatment trajectory is imbedded as to strengthen the vulnerable parts in the safety net. However, as I will argue, not all interventions aimed at strengthening the organization to optimize patient safety can solve the problem.

#### *Risky places and tricky times*

The organizational order has its own vulnerable parts. Take, for instance, the moments of transition. There are many different kinds of transition, like, the start of

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<sup>14</sup> Other studies by the Committee with a specific focus on patient safety followed some years later, including *Crossing the Quality Chasm* (Wiener 2001), *Patient Safety: Achieving a New Standard for Care* (Aspen et al. 2004) and *Aspen et al. 2007 Preventing Medication Errors* (Aspen et al. 2007).

<sup>15</sup> Error rates proved to be high also outside the United States. For instance, in their review about the scale and nature of adverse events in British hospitals the Department of Health (2000) reports that at least 850 thousand patients are involved in incidents per year. This figure reflects ten percent of all annual hospital admissions in the UK. The additional costs are estimated to amount to two billion pounds. The latest study on incident rates in the Netherlands shows that 2.3 percent (30,000 people) of the overall patient population was involved in unintended incidents, one third of which will suffer lasting consequences. Besides the devastating consequences for patients and their families and the loss of trust in the health care system, the additional financial costs are estimated to be 167 million Euros (Bruijne de, et al. 2007).

<sup>16</sup> For instance, the Agency for Health Care Research and Quality in the United States, the Agency for Quality in Medicine in Germany and the Dutch Health Care Inspectorate.

the next shift, the transfer of a patient from the ambulance into the Emergency ward, or taking a post-surgical baby out of the reanimation cart and putting him into his own incubator. But also the multiple hand-over moments about information, knowledge, equipment, responsibilities between the different involved actors and organizations.<sup>17</sup> These are the weak spots in the safety net and deserve much attention. Another example is the differences in expertise and experience between the involved practitioners. This requires a balanced distribution of knowledge that the reality of care practices not always allows. Take, for instance, the extreme instability of a baby after it returns from a cardiac surgery. His instable condition requires the utmost concentration of all staff members involved. In these cases the baby is not 'just' a neonate but also a cardiac patient. For such patients other rules apply and other forms of reporting data are used. Therefore, double-checking is called for when new data are added to the flow sheet. However, a post surgical record and a cardiac one in particular, consists of so many parameters that it is no longer possible to identify intervals between the various checks; those in charge of him hardly pause for a moment and exhausting lie in wait. The complexity of the monitoring of these kinds of complicated cases requires a certain level of specialized knowledge and experience that is still hardly there. Since highly complicated interventions, like open heart surgery, are no daily routines the staff has had little opportunity to gain experience with this type of cases. Although NICU staff has the expertise needed for this kind of treatment, it can be hard to distribute this expertise in a balanced way among the staff that is present at any given moment. Because of staff's rotation and specific disciplinary differences between neonatology and cardiology, intensive monitoring, which is aimed at ruling out risks, becomes a source of uncertainty in its own way, as one of the comments of one the nurses of the Medical Centre demonstrates:

'The same staff members usually provide care to these children. This is why others, including me, do not gain experience in treating them. So you can't expect us to do this straightaway. Just look at how this child is hooked up to everything. I can't do it. I just don't feel experienced enough to take over the responsibility for this baby.'

The best staff members cannot be present around the clock, nor do they do all have as much experience. This applies to both the nursing staff and the medical staff. In a complex case experienced physicians are present at night and during weekends to assist junior doctors to deal with unexpected complications. This does not always prevent near incidents as the following situation will demonstrate:

*General Hospital*

Friday 22:00 hour: Unexpectedly, the saturation level of the blood of the child with the cardiac surgery drops sharply. The attending just left, and the resident is hesitant about what to do. Everyone is anxiously looking at the monitor. At that moment the anaesthesiologist and the cardiologist enter the NICU. They intervene instantly, and after some minutes the screen indicates that the saturation level improves again. The anaesthesiologist is grumbling at everyone because upon entering she noticed that instead of doing something they were all just watching the monitor.

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<sup>17</sup> Handover moments have been a topic of investigation for many studies (e.g. Broekhuis and Veldkamp, 2007; Iedema 2007; Kerr 2002; Manias and Street, 2000)

As being aware of the vulnerability of their organisational systems hospital practitioners and management try to preserve an adequate level of patient safety by initiating and implementing all kind of safety measures. Let us take a look at some of the initiatives that have been taken in health care over the last years.

#### *Safety-measurement-in-action*

In line with the safety policy in other high risk industries, the strategy in health care is geared towards 'learning from mistakes'. Accordingly, the reporting of errors is encouraged (Aspden 2004, p. 1). These reporting systems make it possible for specific practices to aggregate data and recognize trends or patterns of adverse events and transfer back the lessons learned. Use of other information technology, such as the computer physician order entry (CPOE) that provides the electronic infrastructure for doctor's orders on the treatment of patients, contributes to error reduction related to handwriting. Moreover, it has a built-in error-check for medication dose or treatment check. Also the electronic patient record may have a central role in the improvement of patient safety. The ultimate aim is to replace the traditional individual report by an automated surveillance of clinical data (data driven triggers) to detect and prevent events.

In addition to the systematization of health care, the cultivation of a safety culture is stressed (Aspden 2004). A culture of safety entails alertness, openness, transparency, learning and improving, as well as the recognition of inevitable human limitations such as those tied to fatigue, vigilance and memory (Bargain 2006). It also involves professional education, management involvement, open communication lines, leadership, and teamwork. Safety studies in aviation, for example, have shown the importance of teamwork. Crew Resource Management training teaches pilots how to deal with high levels of stress in complex flight situations. Likewise, hospitals organize teamwork training for staff members working in critical care, such as intensive care units, operation rooms and emergency rooms (Helmreich and Schaefer 1994; Randell 2003).<sup>18</sup> By means of a collaborative learning the health care sector tries to make 'breakthrough' improvements' through diffusion of best practices (IHI 2003). In this way it tries to spread evidenced-based knowledge over as many as possible health care organizations.

The development of blame-free reporting systems, electronic patient records, crew resource management training, and the diffusion of best practices and safety cultures are considered essential for the improvement of patient safety. However, the implementation of these safety measures has met with problems. The reporting system, for example, is hindered by a 'culture of blame'. The fear of being blamed and held responsible or being subjected to disciplinary measures inhibits staff members to participate in reporting incidents. Many efforts are geared towards transforming the 'blame culture' into a 'safety culture'. It is recognized that feedback is crucial in motivating physicians and nurses to report errors. Additional measures are taken to overcome the blame culture's detrimental effects. For instance, reporting forms are designed to guarantee the anonymity of reporters. Feedback sessions are organized to show staff members that reporting is a necessary condition for learning from mistakes. Waring (2005) argues, however, it is naïve to think that

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<sup>18</sup> The relevancy of collaboration is not limited to the level of health care practitioners. Collaboration between health care practices is considered a crucial building block for patient safety as well.

it is 'just' a matter of transforming a 'blame culture' into a 'just culture'. Other cultural aspects play a role as well in this matter. For instance, in medical culture errors are considered as an inevitable part of doing medical work. From this perspective incident reporting has little significance. Also, collegiality and a deep-rooted aversion to administrative work (which also comes with more managerial interference) do not contribute to incident reporting among doctors, according to Waring. Additionally, the steep hierarchical structure of medicine makes it more difficult to acknowledge the effects of stress and fatigue or to admit mistakes (Randell 2003). Even when the reporting rate is high, clinicians responsible for the root cause analysis (RCA) of the reports have great difficulty to derive organizational-managerial generalizations from – sometimes contradictory – details of the described situated action (Iedema et al. 2006a). Furthermore, it is expected that their recommendations will result in general rules that will improve the health care system. Although Iedema et al. (2006a) claim that RCA positions clinicians 'in the heart of the disjunction between the complexity of situated practice and the abstractness of formal rules.' (p.1202), elsewhere (2006b) they also stress that this struggle should be no reason to dismiss RCA. Instead, it is argued, RCA creates the opportunity for clinicians to confront their work and have cross-hospital discussions. In other words, RCA engenders a new level of reflexivity of clinical practice.

#### *A relocation of vulnerability*

Not all unintended effects are as positive as the aforementioned reflexivity. Some safety measurements may prevent specific errors but they induce unsafe situations of another kind instead. Take, for instance, the double check of medication – one of the most applied safety measures in medical practice.<sup>19</sup> In neonatal intensive care units (NICU), medication is prescribed by the attending physician but prepared by nurses. The nurses always check if they have prepared the right substance and dose for the correct patient at the right time. Additionally, they will ask a colleague to check their preparations. Because most NICU patients receive their medication around the same time, one will find the nurses working side by side at the medication-desk, where they can help each other to double check their work. In other cases nurses may have to ask a colleague who is busy taking care of one of the babies. But in both situations the request for a double check may affect their colleague's level of concentration. For instance the nurse who is busy next to the incubator might forget that he or she has changed the settings of the ventilator while performing a stressful procedure like suctioning. In this case the double check does not resolve the potential for mistakes, but only relocates the vulnerability of the organisational arrangements.<sup>20</sup> Similarly, the application of information technologies, such as the Computer Physician Order Entry, is not without risks. Although IT is considered the 'magic bullet' for all sorts of problems, it can also introduce other types of error into the care process. Consider, for example, a juxtaposition error where clinicians order the wrong tests due to the screen design or incidents due to the fact that the computerized medication system does not allow alternative practices which are sometimes needed in cases of urgency (Ash, Berg, and Coiera 2004). To deal with the vulnerable parts in the organization is not an easy task. Some measures seem to solve one problem, but create another one. Strengthening

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<sup>19</sup> This example is based on the author's fieldwork in a neonatal intensive care unit in the Netherlands.

<sup>20</sup> In addition, the double check system does not prevent that a medication is not handed out at all.

the safety net in one corner can be at the cost of the robustness of another part. In this case vulnerability is not solved but relocated.

The relocation of vulnerability is also visible in the consequences of the efforts of the NICU staff of the Medical Centre to deal with the disturbances during medical rounds. In the practical order of this NICU there is a condensation of different lines of activity around noon. It is when doctors do their daily medical round, nurses have their lunch break and the condition of the babies needs to be checked. A medical round also involves information of the nurses about the baby's condition and the situation of the parents. However, while doctors are discussing treatment policies next to the incubator, half of the nursing staff is away or planning to do something else (checking the baby). Even when nurses are available there is no guarantee that everything goes well. The nurse who takes care of the baby writes down the doctor's orders on the nursing form. However, a lot of times neonatologists not only tell nurses what can be stopped or needs to be continued, but also change the settings of the machines. Nurses are not always aware of this because they are writing or informing the other doctors about the baby's condition. Or, the other way around, doctors ask the nurse to change the setting, upon which s/he stops writing the information on the nursing form and the doctors continue to discuss the next steps in the treatment trajectory of that particular child. In the meantime, other nurses ask the fellow or attending neonatologist for advice on small but urgent matters and as such interrupt the medical round. On top of this there is the usual NICU-noise like phones and alarm bells which makes it difficult for everyone to hear what has been said. As one can imagine, changing settings, listening to the discussion, informing doctors and writing notes asks for errors and mistakes. Fully aware of this weak spot in their organization, they changed the set-up of the medical rounds. Now the daily rounds are located in the meeting room on the ward. The nurse take turn into the discussion and their presence determine which baby will be discussed at what moment. In this way nurses and doctors are not distracted. However, in the meantime there are no doctors on the NICU. The medical round takes twice as long because the doctors have to wait every time for the nurse. This can take quite some time because nurses are in the middle of their monitoring rounds and first have to finish their tasks and hand over their responsibilities to a colleague. Most of the times their colleagues are already taking care of a number of children since half of the nursing staff is having their lunch break. During these hand over moments the medical staff cannot do anything than wait for the nurse to join them. It is not only the nurses who are the cause of the extended length of the medical rounds. Also the doctors themselves take more time to discuss the children and the medical conditions. With medical textbooks within reach, the educational part of the medical round has increased. The consequence of these work dynamics is a reduction of doctor's availability on the NICU for a considerable amount of time. The problem is not solved, but relocated into the care practice of the nurses.

Besides a spatial relocation, some safety measurements produce a temporal relocation. For example, on the neonatology ward the preparation of medication is positioned in a special satellite of the pharmacy opposite the NICU. Due to this service the level of medication errors has dropped significantly during weekdays. However, during weekends this satellite is unmanned and the nurses have to prepare the medication themselves, including those that are not pre-packaged. Since the satellite service of the pharmacy the nursing staff hardly ever takes care of medication preparation. As a consequence they have lost their skills and knowledge which resulted in increasing medication errors over the weekends.

Examples such as these make clear that it is not so much the use of specific techniques that lead to the reduction of an organization's vulnerability, but rather the (organizational) contexts, including the overall organizational system, in which they are put to use. Despite all the efforts to improve patient safety, it is clear for everyone involved that improving patient safety is hardly a straightforward matter. The level of complexity in health care practices is such that un-intended, collateral effects of safety measurements can neither be predicted nor be prevented. Moreover, some of the measures to cope with the NICU's vulnerabilities actually contribute to an unsafe practice.

### **Conclusive remarks**

On a NICU practice vulnerability can be found in many places. It concerns the level of stability of the vital functions of the NICU patients, the extent to which parents can cope with the emotional burden of not having a healthy child, or the ability of caregivers to withstand infectious identification. But it is not only people who are vulnerable. Also actions, objects, rules and arrangements can be fragile or susceptible for diversion and distortion. However, looking back to all these examples what do they tell us we about vulnerability in a critical care practice like a NICU?

First, the locus of vulnerability on a critical care unit is in the instability of a balance or in the brittleness of a relationship. Vulnerability on a NICU practice is a matter of *balance*. Surviving a premature birth or providing care and treatment in a critical care context is all a matter of finding the right balance. It is for instance, the balance of the in- and output of fluid supply in the baby's body or the balance between the requirement for doing blood tests for data collection and providing comfort. It is also about the necessity to discuss treatment policy and availability on the ward, or the balance between the availability of experienced and less experienced personnel. These balances are instable and require continuous adaptation. Vulnerability in this context is also about *relations*. Besides the relationship between the involved actors, it is also about the relationship between the different vital functions in the baby's body, the morning shift and the evening shift, Some of these relationships need to be tightened, like the mother and child, while others, like the insertion of an IV-line and bloodstream infection, require a loose coupling. Some of these vulnerabilities can co-exist in peace while others compete

Second, vulnerability has a positive flipside that is acknowledged by the actors involved. The vulnerability of the children is regarded as a potential for personal growth of all the involved actors. Additionally it can be considered as something that triggers the alertness of practitioners and the improvement of the sensitivity of machines and the refinement of their settings. The delicacy of the efficacy and safety of the medical interventions also contributes to the level of situational awareness and the significance of patient safety measures. However, some strategies to strengthen the bodies and the practices only *relocate* vulnerability, instead of diminishing it.

Finally, vulnerability comes in many ways. Some are modifiable, other are fixed. Some forms are inborn, while others come from outside. These multiple vulnerabilities co-exist and compete. They can be relocated in time and place. But it

will never leave the NICU practice. Compensated for by the suggestion of control that tends to characterize medical action, the involved actors try to find a way to deal with its presence by stabilizing balances and tightening or loosen up linkages. But no matter their success vulnerability is an integral component of critical care practices.

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