

# Evaluating the Processes of Neonatal Intensive Care

Thinking Upstream to Improve  
Downstream Outcomes

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## Thinking Upstream to Improve Downstream Outcomes

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In a time of drastic change, it is the learners who inherit the future. The learned find themselves equipped to live in a world that no longer exists.

Eric J Hoffer

# Preface

*Instead of seeking new landscapes, develop new eyes.*

*Marcel Proust*

Daily, we must justify – explicitly, objectively – what we do in the neonatal intensive care unit (NICU). And increasingly, we must demonstrate that these activities provide value for those we serve and for the money spent. Even the process of accrediting our care facilities now demands that we understand the fine structure of our work, our results, and how these are related. Accreditation will demand too, that we show continual improvement in what we achieve (Joint Commission on Accreditation of Healthcare Organizations ORYX initiative; [http://www.jcaho.org/perfmeas/oryx/oryx\\_frm.htm](http://www.jcaho.org/perfmeas/oryx/oryx_frm.htm)). If only the skills we acquired during our education and work careers could prove sufficient for meeting these expectations; but all too often our skills fall short of these challenges.<sup>1-4</sup>

For those of us who must close this gap – between our current skill set and the challenges before us – this book aims to send you well along the path toward competently evaluating and improving the work and results of the NICU. I know that you already have too little time in your day. I have strived to make the ideas clear, definite, and relevant; the writing accessible, coherent, and transparent; the conceptual development manageably incremental, intuitive, and logical.

So much of our work, though we look straight at it, lies there unappreciated – important causal relationships remaining obscure unless we specifically think about them and know how to see them. Imagine this: you awaken in a campsite 9000 feet above sea level. The sun is a small orange disc offering no heat, rising above the irregular horizon behind you. The air is frigid, making all you see exist in icy contrast. “I must get a picture of this place,” you say to yourself. As you look at the image of a mountain peak through the lens of your camera, you envision a striking photograph. Patches of white snow are carved into jagged shapes by jet-black shadows. In the foreground, outlined by the ethereal yet deep blue sky, lies a palette of colors created

by the sunlight filtering through the thin air and impacting the hard slope. Pressing the shutter release, you know you will be proud of the result.

What have you just done in this scenario? “I’ve taken a picture of a mountain,” you might say. Ansel Adams, the noted photographer, might answer differently. He might say you have carefully selected light and thoughtfully captured its effects on the film in your camera. This formulation distinguishes the product from the steps that comprise the production process.

*To the extent that we are aware of the component activities of our work, we can then influence or control them.*

- We may not think about the component activities at all.
- We may only think about them abstractly. This approach may paradoxically block our inquiry because of the vagueness inherent to abstraction.
- We may actively think about the fine structure of the component activities.

If you are reading this, your daily work probably is associated with a newborn intensive care unit. How do you view your work? Please take a moment to express your thoughts. Perhaps you say something like “My daily work is helping sick infants get better.” No doubt, this is what you want to *accomplish* by your work. This is the view that equates taking a picture of a mountain with releasing the camera shutter. In this view, many aspects of achieving the desired result fly by so quickly that they probably go unnoticed. How do we formulate a blur? Our distinguishing what we want to accomplish from what we actually *do* enables greater mastery of our work and a deeper sense of meaning for our profession.

We may consider what we want to accomplish by the activity of the NICU to be the aim of our system of care. What we do to achieve the aim is our work. We implement, coordinate, and interpret the results of a rather complex web of *processes*. The picture-taking scenario included the processes of composing an image, focusing the camera, determining exposure settings, and releasing the shutter. The picture is the *result*. It is an underlying assumption in this book that when we broadly and deeply understand component processes, we get better results.

A few years ago I awoke to the importance of answering the question: How can a neonatology group practice add value to its hospital system? When I discussed this with colleagues, too often the responses resembled: “Well, clearly, we’re the quality group,” or, “Just look at our outcomes.” Amazingly, I never heard anyone express concern that their unit might *not* be as good as another NICU in town.

What do we mean by “a good NICU,” or by “doing well?” What are the components of a NICU that add value to the system of hospital care? Answers emerge from examining the fine structure of our work, the results of that work, and considering explicitly why we do our work and how all these concepts are related. For some of us, such a view of clinical neonatology amounts to seeing the NICU with new eyes; and when we do, the landscape changes forever.

We are accustomed to looking at, and thinking mainly about, the end-results of the work of the NICU. “End-results” ordinarily is a redundant word pair. But in this book the term discriminates between terminal and intermediary process results. Often we neglect to examine how the results occurred or how we might alter what we do so that we may get different results.<sup>5</sup> This book is an invitation to look at and think about what goes on “upstream,” in our care processes, so that we may understand and influence the causal webs producing what some call outcomes – the “downstream” end-results.

## References

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- 1 Horbar JD. *A national evidence-based quality improvement collaborative for neonatology, Vermont Oxford Network, 1997, Annual Network Update.* Washington, DC, December 7, 1997.
- 2 Horbar JD. Personal communication based on data from NICUs participating in the Vermont Oxford Clinical Trials Network. Burlington, VT, April 20, 1998.
- 3 Horbar JD. The Vermont Oxford Network: evidence-based quality improvement for neonatology. *Pediatrics* 1999;103(1 suppl E):350–9.
- 4 McCormick MC. Quality of care: an overdue agenda. *Pediatrics* 1997;99:249–50.
- 5 McCormick MC. The outcomes of very low birth weight infants: are we asking the right questions? *Pediatrics* 1997;99:869–76.



# Introduction

*Given the importance of health care, it seems inconceivable that we do not have excellent ways of evaluating how well we are doing. Yet the fact is, we do not ... substandard performance is largely invisible except through a statistical lens.*

*David M Eddy (1998)<sup>1</sup>*

## **We don't work alone**

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I glance at a pencil resting on my desk and I wonder: Is anyone on this planet sufficiently knowledgeable to make a pencil? This apparently simple tool is the outcome of a complex production system involving many people applying diverse knowledge. A pencil results from knowledge and action in the fields of forestry, logging, wood curing, making graphite, making tools, making fuel ... and so on. The various roles of the many people involved in making the pencil must be carefully coordinated so that it eventually comes to rest on my desk.

The situation is the same in the NICU. No single person saves a baby. Because of many people doing many things in coordination, an infant, at one time desperately ill, eventually leaves the unit in his or her mother's arms.

## **Work standards**

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Now consider your one job among the many in the NICU. Think for a moment how you decide that you do your job well. How do you know you did the best possible for that infant going home with their mother? How do you know you did the best possible for the unfortunate infant who did not recover? Do you have explicit standards? If you do have standards for judging your work, how did you get them? Or is it just obvious that you are a good doctor, a good nurse? If you had to, could you prove it? How?

## Three core questions

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This book prepares you to judge and to improve your work and the results of your work. We develop clearly expressed and reasonably sequenced ideas, aiming to answer three fundamental questions:

- 1 How are we doing?
- 2 How do we know?
- 3 How can we do better?

Trying to answer these questions keeps you engaged with your work. This effort continually poses new challenges, and by accepting them you will force incremental growth in your skills. Combined with work aims that you believe in, this is the basis of meaningful and gratifying work.<sup>2</sup>

## Probing the variation among providers; “drilling down” in our work

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Wherever and whenever investigators look at the work of health care, they always find variation in what is done.<sup>3-6</sup> Practice variation, often unrelated to outcome, is causing physicians to lose control in their clinical activities. They are losing control because this variation undermines their scientific legitimacy.<sup>4</sup> Key organizations are questioning whether physicians really know how to evaluate what they do or know how to improve it.<sup>4</sup> Some claim that variation is desirable – it is basic to the art of medicine. This position is indefensible until we can describe and understand the causes and the consequences of the variation (and currently we can't).

To characterize and understand the causes and the consequences of variation in neonatal care we must first understand the daily work of the NICU. Recall the discussion at the beginning of this chapter about the pencil. We seek a broad perspective of work, one that encompasses the *entire* set of tasks involved in NICU operation. Although some readers may have experience examining the more evidently important tasks, the total number of tasks is large, and we have yet to understand them in aggregate. Many of the tasks

may seem mundane and uninviting of scrutiny. Until we carefully examine and understand them all, singly and in their relation to each other, any ranking by relative importance may be wrong. Wrong too, may be our proposed remedies for problems.

To consider seriously the entire set of processes comprising the NICU is intellectually stimulating and can yield profound insights for improving the results of neonatal care. But remember that a few days of continuing medical education may not undo years of professional habits. (Think about this point too when you read Chapter 1, “Systems and our work.”) Habits are usually difficult to change because often they are not isolated behaviors; rather, they are enmeshed with *many* aspects of the systems of which they are a part. Overcoming the difficulty with such change may relate to understanding and working with those interconnections. So take the material in this book and reiteratively think about it, relate it to your experience, struggle with it; *make it part of your daily work, make it part of the way you think*. Do these things from many perspectives, so the interconnections that tend to make old habits hard to eradicate become evident; and once so, the habits are not needed – indeed, not wanted. Along the way you will likely discover new enjoyment of your work.

## **What is quality?**

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Sooner or later, discussions about improving the care in the NICU touch on the notion of quality. Let’s take care of it sooner. How do you define quality? That which emerges when the most resources available are brought to bear on a problem? That which emerges when the most skilled people are involved in a process? Might it simply be whatever a patient (parent) says it is? Perhaps quality is what a consumer buys for the dollars spent in the NICU. In this context, some people believe we should know which NICUs provide better value for money.

Now consider the consensus statement by The Institute of Medicine (IOM) National Roundtable on Health Care Quality:

*The quality of health care can be precisely defined and measured with a degree of scientific accuracy comparable with that of most*

*measures used in clinical medicine. Serious and widespread quality problems exist throughout American medicine. These problems, which may be classified as overuse, underuse, and misuse, occur in small and large communities alike, in all parts of the country, and with approximately equal frequency in managed care and fee-for-service systems of care. Very large numbers of Americans are harmed as a direct result. Quality of care is the problem, not managed care. Current efforts to improve will not succeed unless we undertake a major, systematic effort to overhaul how we deliver health care services, educate and train clinicians, and assess and improve quality.<sup>7</sup>*

If you merely scanned this paragraph in small print, please go back and read it slowly. The powerful statements, well documented in the report, clearly call for reconsidering old beliefs, and changing what we do. Precisely how does the IOM define the notion of quality?

The IOM calls quality of care:

*... the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge.<sup>7</sup>*

For many years now, this definition has withstood critical review from various perspectives and remains useful. It is robust. Here again, I suggest a second reading. Notice that it implies a causal relationship between health services and health outcomes. Recall this definition of quality as you engage with the entire set of tasks involved in neonatal care, and as you measure causal events and end-results.

## **How we will approach quality improvement?**

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This book aims to help improve the mean level of quality (using the operational definition of the IOM) in your NICU. We will take a systems perspective, to explore how the systems we create allow or even facilitate errors and waste. We will eschew an all too common habit of blaming individuals for errors when all they were doing was what the system demanded of them. We will examine processes and outcomes, indicating the importance and need for process data and showing limitations of some outcome data. "Process data are usually more sensitive measures of quality than outcome data,

because a poor outcome does not occur every time there is an error in the provision of care.”<sup>8</sup>

## **Lessons from Japan about quality and cost**

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In 1984 the infant mortality rate in Japan was one half that in the United States (US). Perhaps even more surprising, Japan’s per capita spending on health care was one third that of the US. Remarkably, the English language health care literature and the Ministry of Health in Tokyo offered no comprehensive explanation for the phenomenon. Japanese auto manufacturers were then a focus of attention in the US, and my hunch was that the efficiency of the Japanese health care system was a reflection of a Toyota-like approach to delivering health care. In 1986 I obtained support from the World Health Organization (WHO) and the US Department of Health, Education, and Welfare (HEW) to learn about delivery and outcomes (including cost) of health care for infants in Japan.

Surely, I thought, such good health outcomes at such relatively low cost must reflect an advanced production process. This was correct, but not primarily with respect to the hospital-based neonatal health care process. I learned that the advanced production process (resulting in low infant mortality rates) was based more in the cultural norms of everyday life rather than in the organizations directly delivering health care. The Japanese way of living appeared to produce healthier babies.<sup>9</sup> Societal resources seemed more devoted to *preventing* problems than *fixing* them after they occurred. As a result, demand for the more expensive component of the infant health care system – newborn intensive care – was low, and so was total resource use for neonatal care. Further, low demand sectors understandably experienced little pressure to become organizationally advanced. Today the health care systems of many countries are under pressure to develop advanced and more efficient methods. Per capita spending on health care in the United States (US) exceeded 14% of GDP by 1993 (data from Organization for Economic Cooperation and Development (OECD), 1995<sup>10</sup>), remained approximately level for the decade, and is projected to exceed 16% of GDP by the end of 2010 (Centers for Medicare and Medicaid Services<sup>11</sup>).

Regrettably, I did not visit the production facilities of Toyota during my work in Japan. This company has successfully inverted the relationship between quality and cost that originally obtained in the automobile industry. No longer do economists maintain that as quality improves cost must increase. Toyota accomplished the inverse relation between quality and cost by changing from mass production to “lean production,” and their methods are applicable to perhaps all areas of human activity.<sup>12</sup>

Lean production combines aspects of craft production and mass production. Craft production entails highly skilled workers making a particular thing that a client commissions. The craftsperson and the client are usually pleased with the work and the results, but the process is expensive. Mass production was developed early in this century in an attempt to bring goods to more people at lower cost. Mass production turns out a large number of standard products at relatively low cost. In this case, workers often complain of unfulfilling work conditions while the consumer, given the choice, often seems to prefer a version produced by a craftsperson (better quality).

Why, you may ask, do we seem to digress and now discuss producing cars? We do so because factors that turned around the fortunes of Toyota after World War II illuminate important premises in our story about evaluating and improving neonatal care.

Lean production is a way of making things that involves continuous improvement. Lean production is “lean” because more product results from fewer resources. Mass producers and lean producers think differently about their products. Mass producers set quality standards at “good enough.” It would just be too expensive to do better. *Their quality focus is downstream, on the end results.* They inspect what appears at the end of the production line and make final adjustments by reworking the end result. *For lean producers, on the other hand, the focus is rather diffuse – they look upstream and downstream.* They alter end results by adjusting upstream processes, *preventing* the problems that mass producers discover during final inspection. Lean producers are after perfection. They know this goal is unreachable, but using it as the standard underlies their success. Aiming for perfection changes the way people work, the way they think, and (yes), even the way they live.<sup>12</sup>