

Gravens By Design: “Hands-Off” and “Hands-On” Care in the NICU: Can They Coexist and be Mutually Reinforcing in the NICU of the Future?

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In this decade, we have witnessed the steady growth of both “hands-off” and “hands-on” care in the NICU. While at first glance, these would seem to be competing concepts—and indeed, they have been in many respects in the early part of this decade. Experience with both concepts has grown, and now a new factor has emerged—artificial intelligence (AI), which may help us find a way to realize the benefits of both strategies while avoiding most of their downsides.

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I will define “hands-off” care as the intent to avoid stress in high-risk newborns whenever possible by limiting any “unnecessary” (a concept mostly in the eye of the beholder since there is a paucity of data available to define this) sensory input, to include not only touch but also visual and auditory stimuli. This concept was born out of an era in the early days of NICU care when infants were subjected to excessive stimuli of all sorts—except for human contact, which was extremely restricted.

I will define “hands-on” care as the effort to keep babies in the arms of a parent or surrogate as much as possible, even very soon after birth and even if receiving intensive care in the form of endotracheal intubation, umbilical vessel catheterization, and other similar invasive measures. This, too, can be seen as a reaction to the minimal access given to parents in the early days of NICU care but obviously with a much different philosophy to the “hands-off” approach. Both strategies are intended to minimize the stress on the newborn so they can thrive, but through entirely

different methods.

Both “hands-off” and “hands-on” care have advocates who have produced strong scientific evidence that their approach has led to better outcomes than in previous eras. Intraventricular hemorrhage (IVH) prevention protocols embrace a number of “hands-off” practices and, when bundled together, have been shown to reduce the incidence of IVH. (1) However, there is little evidence that any individual component of the bundle (such as minimal touch or continuous dim lighting) is essential to the success of the bundle. In many NICUs, most components of these bundles are continued well beyond the time frame used in the studies to show benefits for IVH prevention; in particular, infants on ventilatory assistance are often kept on “minimal stress” precautions for weeks or months. Notably, one characteristic of these protocols, formal or informal, depending on the NICU, is that parents are given limited opportunities to hold their babies while they are on ventilatory assistance.

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On the other hand, proponents of “zero separation” have shown that even the highest-risk infants can be safely held by their parents and exposed to various auditory and visual stimuli in the first days of life, with outcomes comparable to the most cautious NICU protocols. (2) A third trend has emerged, that of AI, although it has yet to have practical applications in the NICU with respect to these challenges.

Can we project how each of these well-intentioned strategies might play out in the coming two or three decades (the typical lifespan of a NICU), so that someone currently planning a new

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NICU will create an environment of care that gives its babies, families, and caregivers the maximal benefit of all of these trends?

Let us start with basic goals, which I suggest can be identified as follows:

- Support infant homeostasis to the greatest degree possible in order to optimize growth, development, and healing.
- Optimize parent-infant interaction to the greatest degree possible.
- Provide caregivers with as much information as possible to guide their care, packaged and processed, to maximize the accuracy and thoroughness of medical decision-making.

In today's NICU, "hands-off" and hands-on" strategies are intended to support homeostasis, thereby minimizing stress and its related complications, although they seek to achieve that goal through very different methods. Could AI help here? Perhaps so—one of AI's most obvious uses would be detecting imperceptible changes and trends in a patient's status and either alerting a caregiver or implementing a change in clinical support according to the given directions. Consider, for example, our current method of adjusting ventilatory support for a very preterm infant in the first days of life. In the first era of neonatology, we adjusted oxygen input based on visual assessment of color and frequent arterial blood gases; we adjusted ventilator settings based on those same blood gases and ancillary tests such as chest X-rays. With the advent of transcutaneous O₂ saturation and pCO₂ monitors, we obtained real-time continuous data, occasionally confirmed with much less frequent blood gases, but usually could make adjustments in oxygen concentration and ventilator settings based on the transcutaneous information. It is only a matter of time before AI can receive that same information as well as data from the ventilator itself and, based on parameters determined by the clinician, make adjustments in ventilator settings continuously, still with intermittent adjustments in either actual settings or the parameters being used by AI by clinicians as they see fit.

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One can imagine a similar strategy being employed to manage continuous drips to support blood pressure or blood glucose. It is perhaps a little more of a stretch to imagine how sensory input could also be managed with the help of AI. However, let us agree that the goal should be to minimize noxious stimuli and maximize nurturing stimuli. We must only identify how we judge an infant's

response to a given environmental input to determine whether it should be limited or encouraged. It is very likely that we already have access to continuous data, such as heart rate, cerebral oxygenation, and brain wave activity, which can be used for this purpose once we learn how to train an AI helper properly.

If AI could provide directed, automatic intervention as well as alert clinicians to times when an infant needed more direct attention, it should be possible to put an infant in the arms of his/her parents with the assurance that homeostasis would be maintained or the clinician alerted when that was not possible within the parameters selected. In this future, but perhaps not too distant scenario, babies could be safely in the arms of a parent or surrogate most of the time.

"What impact would this next era of care have on NICU design? First NICUs will not need to be constructed with "line of sight" considerations...All the information once gained by this design consideration is now available through the interlinking of monitors, cameras, and personal communication devices... Second, it is likely that we can customize each infant's immediate environment—lighting, auditory, temperature, humidity, etc.—to their specific need, rather than using a 'one size fits all' approach that we have been forced to use until now. Third...we can design our NICUs in a way that fully supports a parent or parents who want to essentially live with their baby during the NICU stay, and therefore create patient rooms and support spaces that welcome families as an integral part of our care team, rather than as visitors."

What impact would this next era of care have on NICU design? First—and we are probably already there—NICUs will not need to be constructed with "line of sight" considerations in which nurses would have direct visibility of their baby's bed. All the information once gained by this design consideration is now available through the interlinking of monitors, cameras, and personal communication devices. This does not mean that nurses will not have direct contact with their patients; their bedside duties will remain, but when they are away from the bedside, they will still receive all the information they need about their patient's status electronically. Second, it is likely that we can customize each infant's immediate environment—lighting, auditory, temperature, humidity, etc.—to their specific need, rather than using a "one size fits all" approach that we have been forced to use until now. Third, if we can safely provide care to babies while they are being held for extended periods, we can design our NICUs in a way that fully

supports a parent or parents who want to essentially live with their baby during the NICU stay, and therefore create patient rooms and support spaces that welcome families as an integral part of our care team, rather than as visitors.

It will be a brave new world, but babies will get even better care while minimizing stressors for caregivers and families. The NICUs that do this best will be designed with these changes in mind.

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