

The Epigenetic Wild Card: Rethinking Current Practices for Future Safety

Rob Graham, R.R.T./N.R.C.P.

I dedicate this column to the late Dr. Andrew (Andy) Shennan, the founder of the perinatal program at Women's College Hospital (now at Sunnybrook Health Sciences Centre). To my teacher, my mentor and the man I owe my career as it is to, thank you. You have earned your place where there are no hospitals and no NICUs, where all the babies do is laugh and giggle and sleep.

In the rapidly advancing field of medical science, what appears safe and benign today may prove to be not so in the future. This is particularly true when considering the intricate dance between our environment and our genetics—an interaction known as epigenetics. Epigenetics, the study of how behaviors and environmental factors can cause changes that affect gene expression, has unveiled the profound impact our surroundings can have on our DNA. These changes can sometimes lead to unforeseen health issues, turning what seemed like a minor risk into a significant threat over time.

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One area where this is particularly concerning is the exposure to oxygen and its role in DNA damage. While oxygen is essential for life, high levels or prolonged exposure, particularly in medical settings, can lead to oxidative stress and DNA damage. This raises questions about the long-term safety of certain medical practices that involve high oxygen levels.

Chemical exposure from medical devices is another critical concern. For instance, certain plastics and coatings used in medical devices have been found to leach chemicals that may have epigenetic effects. These chemicals can disrupt normal gene expression, potentially leading to health issues later in life.

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The Australian childhood cancer relative risks study highlights another dimension of this issue. The study suggests that some medical practices while addressing immediate health needs, may inadvertently increase the risk of cancer in children. For example, certain unavoidable conditions, such as prematurity, necessitate interventions that might carry long-term risks. However, other practices, such as elective Cesarean sections (C/S), warrant careful evaluation. The associations between these practices and increased cancer risks call for reevaluating their widespread use.

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Inhaled nitric oxide (iNO) therapy is a potent eye-opener in this context. iNO can be a lifesaver for treating persistent pulmonary hypertension in newborns (PPHN). However, its long-term safety remains under scrutiny. Should we consider more aggressive ventilation strategies before resorting to iNO? Moreover, if iNO is necessary, should it be weaned aggressively to the lowest possible dose and administered for the shortest possible time? These questions highlight the need for caution and a thorough evaluation of our current practices.

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Stress in and of itself has known epigenetic consequences. One of the earliest indicators of possible epigenetic triggers for homosexuality came from a German study. It found that those born in post-WWII Germany were more likely to identify as homosexual. Living conditions at the time were akin to hell on earth, and maternal stress levels were invariably high. (Homosexual etiology was the topic of my first year psychology final essay.) We would later find that maternal stress in the first trimester could alter hormonal expression. Scans have shown that the brains of gay men have a similar reaction to women's when exposed to estrogen.

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It could be argued that babies arrive in the NICU with epigenetic guns pre-loaded from intrauterine stress. Every procedure, sound, and bright light are added stressors that have the potential to alter gene expression later in life. The risks associated with early antibiotic exposure are adding up, but antibiotic stewardship notwithstanding, the use of antimicrobials can be all but eliminated through strict adherence to excellent infection control policies.

The evolving understanding of epigenetics underscores the importance of rethinking our medical interventions. We must consider not only the immediate benefits but also the potential long-term consequences. As we navigate this complex landscape, a more cautious and evaluative approach to medical practices may be necessary to safeguard future generations from unintended harm. A “hands-off” approach in the care of our patients may be the safest, most potent medicine we have to offer.

Reference:

1. Bembea MM, Ng DK, Carroll M, Roem JL, Groopman J, Caprarola SD, McElrath Schwartz J, Felling RJ, Salorio CF, Ellis G, Graham D, Everett AD. Cyclohexanone Exposure in Children on Extracorporeal Membrane Oxygenation Support. ASAIO J. 2022 Mar 1;68(3):419-425. doi: 10.1097/MAT.0000000000001463. PMID: 33989209; PMCID: PMC8586036.

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