Editorial

THE PROMISE OF PERSONALIZED CARE IN THE INTENSIVE CARE UNIT

By Cindy L. Munro, RN, PhD, ANP, and Richard H. Savel, MD

Personalized medicine, the "careful matching of your biology to your medical care,"[1] holds great promise for improving patient outcomes. All health professions can apply the principles of personalized medicine within their own disciplines, and personalized approaches should drive interdisciplinary care.

Neither personalized medicine nor the broader concept of personalized care delivered by the interdisciplinary team have been widely applied to critically ill patients. The lack of personalized care may seem counterintuitive, since the care of critically ill patients is highly individualized. Although critical care clinicians usually do not know the patient prior to hospitalization, they quickly acquaint themselves with the problems that brought the patient to the intensive care unit (ICU) and with the preexisting diseases that may impact their care and clinical course. Families are involved, and patient and family wishes regarding care are explored. So how does personalized care differ from the individualized patient-centered care we currently provide, and why is personalized care so vital to improving outcomes for critically ill patients?

Currently, individualization of care for ICU patients focuses on quantitative point-in-time data gathered directly from the patient (such as vital signs, laboratory values, and diagnostic test results) and on psychosocial and spiritual aspects of care. Pharmacologic dosing may be tailored using generic formulas based on patient weight or organ function (as reflected, for example, by creatinine clearance), many of which were originally developed for other patient populations.

Other treatments are frequently driven by "one size fits all" guidelines, with ongoing calibration based on a patient's response to therapy. When we individualize care, we generally do so on a case-by-case basis driven by available clinical knowledge and intuition. Where choices must be made, patient and family decisions are usually based on their values and preferences, ideally informed by discussion with providers about the likely potential risks and benefits of available therapeutic alternatives. However, assessing potential risks and benefits for a unique patient is difficult.

Beyond Current Care Practices

Whereas these aspects of individualized care are important, personalized care requires going beyond our current practices to understand and predict the effects of therapies based on each patient's distinctive characteristics so that clinicians and families can make more informed choices about care. Personalized care must be grounded in evidence, and depends on high-quality research about how patient characteristics influence risks, responses to interventions, and prognosis. Individualized care is reactive, starting from generic interventions and adapting as needed; personalized care is proactive, starting from the uniqueness of the patient.

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making related to prescribing medications. In cases where the relationships among genes and drug response have been elucidated, the initial choice of drug and dose can be tailored to a patient's genetic makeup to maximize therapeutic benefit and reduce the risk of untoward effects.

Pharmacogenomic information has already begun to influence prescribing decisions, particularly in oncology and cardiology, but has not yet had a significant impact on critical care practice. However, use of genetic/genomic profiles to understand risks and guide treatment is not limited to pharmacogenomics. In an elegant research report this year, Davenport and colleagues[2] found that expression of 7 genes could be used to classify ICU patients on admission with sepsis into 2 distinct "sepsis response signature" groups. The 2 groups differed in immune responses and in mortality, even though the 2 groups could not be distinguished by clinical characteristics. The authors propose that sepsis response signatures could identify high risk patients, permit development of novel personalized interventions, and improve our understanding of sepsis pathophysiology. Gene expression investigation will likely yield important knowledge about other aspects of critical illness.

More broadly, personalized care involves consideration not only of genetic/genomic information but of other biologically relevant variables as well. Biologically relevant variables such as sex, age, and body mass index are important factors in patient outcomes, but how these variables should be used to personalize care has not been well studied in critical care research. The National Institutes of Health and the Agency for Healthcare Research and Quality recently have issued new regulations for research to increase scientific rigor and transparency and to enhance the reproducibility of research findings.[3] The new guidance requires that investigators account for biologically relevant variables in study design and analysis, and specifically calls out sex as a biologically relevant variable to be considered.[4]

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Clinical research routinely presents demographic information that includes biologically relevant variables; however, the data are usually presented to describe the sample rather than being included in the analytic strategies. When biologically relevant variables are presented as sample descriptors, we can judge how representative the sample is of the population (for example, the balance of men and women), but these descriptive data offer little guidance that would provide direction for personalized care.

New Research Is Imperative

It is imperative that critical care research move forward with understanding how biologically relevant variables affect care, and we must act on that knowledge. Biologically relevant variables may affect risk, and are important in targeting surveillance and prevention efforts to greatest patient benefit. For example, a recent meta-analysis found that advancing age is a strong risk factor for ICU delirium,[5] and this information has shaped targeted delirium prevention protocols.

Biologically relevant variables may affect prognosis. In a recent national cohort study analysis of long-term survivors of sepsis following cardiopulmonary resuscitation, both male sex and advancing age were significant predictors of mortality.[6] Biologically relevant variables may direct personalized interventions at the bedside in the same way that genetic/genomic data have begun to direct pharmacologic interventions. Research to expand our knowledge about personalized care will enable critical care clinicians to align patients who are most likely to benefit from receiving an intervention to delivery of that intervention at a particular point in time or in a particular way.

Challenges and Potentials

Personalized care will present challenges. Research studies may require increased sample sizes to have adequate statistical power necessary for examination of biologically relevant variables. It may require larger multisite studies with associated logistic and funding issues. Importantly, each individual is a unique expression of a multitude of characteristics, and models of personalized care will only be able to accommodate a finite set of those variables.

In the future, whole genome sequencing may become routine and genetic/genomic data will be readily available as part of the medical record. Until

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that time, access to genetic/genomic data for decision making in critical care will be limited, and we will continue to infer genetic risks from family history. Clinical decision support systems that could assist in making sense of a larger set of personalized data, including genetic/genomic data, are still in their infancy and beset with hurdles related to implementation and provider acceptance.[7]

A New World of Patient Care

Our patients will benefit when we develop a deeper understanding about how their personal characteristics affect their care. Critical care practice will improve as a result of a systematic application of that understanding to optimize outcomes for each patient. The best approaches will maintain individualized care, which is grounded in physical functioning, psychosocial and spiritual well-being, and patient values and preferences, while at the same time incorporating the exciting, innovative potential of personalized care, which is grounded in each patient's unique biological characteristics and individual variation.

The statements and opinions contained in this editorial are solely those of the coeditors in chief.

FINANCIAL DISCLOSURES
None reported.

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