

# Facilitating Resilience Using a Society-to-Cells Framework

## A Theory of Nursing Essentials Applied to Research and Practice

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The resilience potential of each human being is an essential focus of nursing care and research. An honored nursing tradition is viewing each patient in the context of family and culture and recognizing how these factors affect a patient's health and ability to be resilient. We present a society-to-cells nursing theory that formalizes and extends this holistic view of patients by delineating factors that contribute to resilience potential based on the society, community, and family environment in which people live, as well as individual variables that influence psychological, physiological, and cellular coping abilities. We also summarize how this perspective is essential to optimize patient care and to inform future nursing research. **Key words:** *family, gender, genetic, physiologic, resilience, sex*

### INTRODUCTION TO THE SOCIETY-TO-CELLS RESILIENCY MODEL

“It is the very nature of life to strive to continue in being. Since this continuance can be secured only by constant renewals, life is a self-renewing process.”

—Philosopher John Dewey, 1899

A challenge (eg, loss of a job, declining health of a family member, violence, aging, or adverse health conditions) exerts a demand

that the individual must meet by adapting in some manner.

Resilience is resistance, recovery, or rebound of mental and physical health after a challenge. Resilient capacity and the extent to which individuals develop this capacity result from interactions with societal, community, family, individual, physiological, and cellular factors across the life course. It is the essence of nursing practice to facilitate resilience capacity through actions in that initiate change in all factors.

Individual resilience trajectories differ markedly depending on the nature of the challenges, the intrinsic qualities of the person meeting the challenges, and the environment in which he or she lives. The developmental timing of challenges also influences resilience, as does the cumulative effect of challenges over a lifetime. These factors affect people's resilient capacity and explain some observed health disparities. Few prior resilience models have conceptualized it as a process largely determined by the cumulative interaction of environmental factors, such as society, community, and family, and individual factors, which include physiologic and genetic characteristics.

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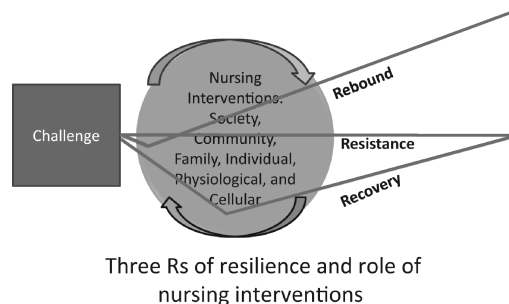
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Therefore, we propose a society-to-cells theory to understand health differences and guide interventions at 6 different levels.

### What is resilience?

Health is akin to resilience as the latter is posited by many nursing theorists, and has evolved with the conceptualization of the essentials of nursing practice. The concept of “health” has evolved from Florence Nightingale’s conception of nurses as promoting recovery from the effects of the environment.<sup>1</sup> Resistance which recognized as an individual’s ability to reduce the potential harm of a challenge was recognized as a fundamental nursing intervention by Dorothy Orem who introduced the concept of “self-care.”<sup>1</sup> Self-care was described as ways a nurse could foster the skills of individuals so that they are better able to prevent future threats to health. Hildegard Peplau provided additional insights into this process and explicated that it was the interpersonal relationship between a patient and nurse that fosters resistance.<sup>1</sup> An integrative perspective of how resistance and recovery are obtained was offered by Pender, Murdaugh, and Parson, who indicate that it is the role of nurses to promote health, through recognizing the 5 personal variables (physiological, psychological, sociocultural, spiritual, and developmental) along with environmental factors, health and wellness or illness factors, and nurse factors.<sup>1</sup> Rebound was first described as an outcome following a stressor by Rosemarie Rizzo-Parse, who defined rebound as the development of new perspectives and capacities that result in a higher level of functioning than that prior to a stressor.<sup>1</sup> Recently, Gillespie et al, introduced the term resilience in nursing, and explicated resilience as a process that allows some individuals to grow from stressors which involves a synergy between an individual and their environment.<sup>2</sup> These theorists provide fundamental insights into the meaning of health, and inform our proposal of resilience as comprising 3 Rs: recovery, resistance, and rebound (see Fig. 1).

Theories of resilience in other disciplines have defined resilience, including the process



**Figure 1.** Three Rs of resilience and role of nursing intervention.

and outcomes, in contrasting ways including resistance, rebound, and recovery. For example, some theories suggest that resilience is merely a lack of biological or psychological compromise following a challenge. Biological theories provide in-depth explanations of the complex mechanisms that individuals undertake to maintain biological functioning.<sup>3</sup> Psychological resilience theories have used terms such as “hardiness,” “invulnerability,” and “stress-buffering” to describe individuals who do not show compromise following a challenge.<sup>4</sup> In our model of resilience, this state of noncompromised function following challenge is termed “resistance.”

Another conceptualization of resilience is *rebound*, which describes individuals who have thrived or flourished in spite or because of challenges. Alternative terms for this process include *poststress growth* or *posttraumatic growth*.<sup>5</sup> According to Viktor Frankl, a psychiatrist who survived the Nazi concentration camp at Auschwitz, “Even the helpless victim of a hopeless situation, facing a fate he cannot change, may rise above himself, may grow beyond himself, and by doing so change himself. He may turn a personal tragedy into a triumph.” In our model, this outcome is termed “rebound,” and reflects the attainment of a positive outcome following a stressor that improves the individual’s functioning ability.

Lastly, resilience has also been acknowledged as recovery from diminished functioning capacity immediately following a challenge. We use the term “recovery” to capture

this component of resilience. In the society-to-cells theory, we posit that resilience can be manifest in resistance, recovery, and rebound processes, and view resilience as a process in which all individuals engage as they progress through life (see Fig. 1).

### **What is the role of nurses in resilience?**

Nurses witness tragedies, suffering, and injustice. It is nurses' responsibility to nurture their patients, as well as their patients' families, communities, and societies to ameliorate immediate harm and to foster recovery, resistance, and rebound, depicted in Figure 1. This view is informed by the essence of nursing practice and is based on the unique perspectives of nursing theorists, who posit that nursing practice is holistic, recognize that individuals are in constant adaptation to their environment, and that adapt nursing interventions to respect individual differences. Below, we briefly discuss nursing theorists' ideas on the essentials of nursing practice, and explicate how the society-to-cells model of resilience builds on these key theories.

The importance of viewing an individual within their environmental context is essential to nursing practice. Dossey, Keegan, and Guzzetta assert that it is essential to view people holistically to design care based on individual differences, which enables nurses to provide interventions that foster abilities and minimize difficulties.<sup>1</sup> Care based on individual differences is informed by intuitive knowledge of how best to intervene for patients based on emotional, social, and biological needs, assert Benner and Wrubel.<sup>1</sup> Afaf Meleis provides a structured perspective on the basis for successful individualized nursing care, including critical thinking, mastery of knowledge and skill, integration of theories and research, and a commitment to life-long learning.<sup>1</sup> The impact of recognizing culture in nursing care is explicated by Madeleine Leininger, who asserts that a person must be viewed within his or her culture, and that interventions to attain health must be culturally congruent.<sup>1</sup> It is through a combina-

tion of these essential theories that the assumptions underlying the society-to-cells theory of resilience were developed, which include nursing care that is based on individual differences and use of the expert qualities of nurses.

Recognition of the individual as constantly adapting to the environment is also an essential tenet of nursing practice. Nursing theorists, including Johnson, Neuman, King, Roy, and Parse, recognize that patients attain health through a dynamic and integrative process of adaptation to the environment.<sup>1</sup> However, nursing theorists differ in what factors are involved in this process of adaptation. Dorothy Johnson viewed health as an interaction of biological, psychological, and sociological factors.<sup>1</sup> Sister Callista Roy further developed these ideas into the adaptation model, which includes the role of cognitive processes as moderating the response to the stressor as well as the impact of a stressor on view of oneself.<sup>1</sup> Key insights into this process were provided by Imogene King, who described the importance of a patients' personal values in their abilities to adapt to stressors.<sup>1</sup> Lastly, a key insight into the adaptation process was offered in The Systems Model developed by Betty Neuman, who recognized the cumulative nature of stressors on the ability of the individual to maintain balance.<sup>1</sup> The society-to-cells resilience model extends these theories by providing a comprehensive lens to view the process of resilience through societal, community, familial, individual, physiological, and cellular factors.

Although our society-to-cells resilience theory is partially formed by the described nursing theories, existing nursing theorists have not explicated how individual level resilience influences other levels of resilience. For example, Parse's Human Becoming Theory recognizes adaptation as influenced by biological, physiological, and sociological factors, but does not explicate how an individual's successful adaptation can influence these factors.<sup>1</sup> Roy also describes the role of nurses in promoting individual adaptation through 4 main interdependent processes;

physiological, role function, self-concept, and interdependence, but not how completion of these processes can alter the environment.<sup>1</sup> An improved recognition of the role that individuals play in shaping their environments, as well as environmental impact on individuals is offered by Anderson and McFarlane, who assert that individual changes are only maintained through community change.<sup>1</sup> From these prominent theorists, we not only view the individual adapting to these systems, but also these systems (family, community, and society) adapting to the individual. These theories recognize that the essential practice of nursing is to promote adaptation. The levels of intervention range from physiological to societal factors that preserve health, and are based on the recognition of individual differences and motivated by caring. The society-to-cells resilience model recognizes that it is the role of nurses to promote resilience through thoughtful interventions that promote recovery, resistance, and rebound in individuals as well as their families, communities, and societies.

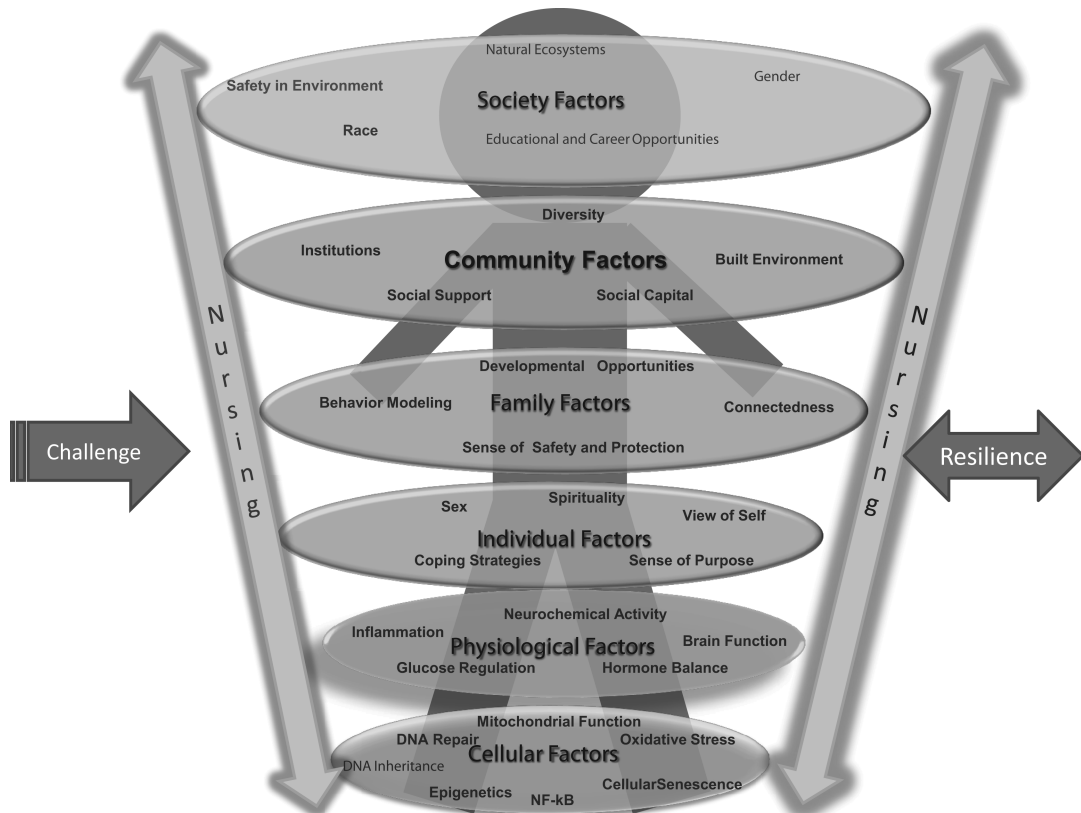
### **SIX TENETS OF THE SOCIETY-TO-CELLS MODEL OF RESILIENCE**

The society-to-cells resilience theory is based on 6 fundamental tenets. First, each person is born with resilient potential. That potential changes over time depending on interactions between society, community, and family, and individual psychological, physiologic, and cellular factors and how each factor reacts to a challenge. Challenges can be external, for example, a traumatic event, or internal, for example, the process of aging. Although aspects of the factors included in the model may also be viewed as challenges, this model recognizes each challenge as unique and the response to it as an interaction of the model factors, which result in divergent health trajectories. Second, on the basis of the resilience literature, we posit that resilience includes 3 aspects: (1) resistance to a chal-

lenge, resulting in the continual maintenance of health (eg, experience of a traumatic event without development of a psychiatric disorder), (2) recovery from a challenge, resulting in a return to previous levels of functioning after a period of compromised functioning (eg, development of insulin resistance that resolves following diet and lifestyle modification), or (3) rebounding from a challenge, resulting in the attainment of a higher level of functioning than before the challenge (eg, finding greater purpose in life after the loss of employment) (Fig. 1). Third, nurses can foster resilience through action affecting 1 or more factors, and this action has increased possibility of affecting comprehensive change if it addresses multiple factors. Fourth, each factor may interact with all the other factors (see Fig. 2). Fifth, just as there may be particularly vulnerable periods of risk (eg, Barker's fetal origins hypothesis), there are times during which an individual, community, or society may be particularly resilient in meeting a challenge. Sixth, resilience is both a process and a capacity. Resilience can be measured in studies as an outcome but is also a measure of theoretical resilient capacity. This perspective is essential, as all individuals are in constant adaptation, and the process of adaptation must also be considered a facet of resilience, not only the final outcome.

### **The 6 factors: from society-to-cells**

We now describe and synthesize the factors in the resilience model through use of relevant examples. These examples are illustrative, not exhaustive. A comprehensive review of the societal, community, familial, individual, physiologic, and cellular factors that promote resilience would be prohibitive. It is also outside the scope of this article to broadly critique the strength of the literature on the relationships between each factor. In this article, we provide examples of types of factors that might interact to create resilience (Fig. 2). Moreover, we recognize that many factors within the categories are overlapping and not mutually exclusive; however,



**Figure 2.** The society to cells resilience framework.

this overlap highlights the interconnected relations between all the factors included in this theory. Also, because of the overlap, some factors may seem placed arbitrarily in 1 domain rather than another. Describing and testing the strengths and weaknesses of the interconnections will be the subject of future research.

## SOCIETY

To paraphrase Agee and Evans (1960), the potential of the human race is reborn in *every* new child no matter what the child's circumstances are. Societies also change through responding to new opportunities and challenges. These changing societies impact individuals' resilience capacity by fostering career, economic, physical, and

emotional development opportunities. If these opportunities are equitable to all, then resilience is universally fostered; however, if opportunities are not equitable because of race, gender, socioeconomic factors, or area of residence, then subsets of society may be at increased risk for reduced psychological and physical health. Although societal beliefs determine resource allocation and influence resilience, it is the individuals of that society who either support the societal belief systems or incite change. Thus, there are constant opportunities to exert positive change through responding to inevitable challenges and opportunities.

## Natural ecosystems

Humans continually interact with natural ecosystems, with each influencing the health



and well-being of the other. Holling and Gunderson define ecosystem resilience as “the magnitude of disturbance that can be absorbed before the system changes its structure by changing the variables and processes that control behavior.”<sup>6</sup> Resilient societies are dependent on the natural resources of an accessible ecosystem to provide not only the required sustenance and materials but also developmental opportunities.

### Safety in environment

A safe environment is the one in which individuals can *avoid* emotional or physical threats, including physical violence committed by another individual, environmental contaminants, and accidents that cause injury. Environmental safety, such as freedom from fear of neighbors, can allow access to outside environments. This access can promote a healthier population, given links between outdoor exercise and positive physical and emotional health.<sup>7</sup>

### Educational and career opportunities

Education fosters resilience through the development of a positive view of self-efficacy and mastery, sense of purpose, social development, and problem-solving skills,<sup>8</sup> as well as increased access to resources such as income, and increased engagement in healthy behaviors. Different societies vary in providing equal educational and career opportunities to both genders and all races, with those providing equity promoting improved success for all individuals. Career opportunities in adulthood provide opportunities for adults to pursue meaningful employment, which increases self-efficacy and sense of purpose.<sup>9</sup> Higher education is also associated with an increased propensity to exercise, to abstain from tobacco use, and to maintain a healthy body weight. Furthermore, it improves access to new health information and technologies that may ameliorate some health problems and promote longevity.<sup>10</sup> One example of a novel resilience-promoting intervention is the Experience Corps, which placed older

African American individuals in urban elementary schools to serve as role models for young students. This intervention increased social, physical, and cognitive activities of older adults, thereby facilitating resistance to the negative effects of aging<sup>11</sup> while simultaneously decreasing behavior problems in the school children.

### Gender

“One is not born a woman, one becomes one.” Simone de Beauvoir (1949). *Gender* is a socially constructed role that is shaped by what society considers appropriate for men and women, whereas the sex of the individual is inherited and a biological construct. Gender is a complex social determinant of health, with both genders being resilient in different capacities. However, inequalities have historically shown that women are disadvantaged relative to men, which may result from reduced opportunities for education and paid employment, decreased social status in families, communities, and society, limited access to and control over resources, limited decision-making power, and increased vulnerability to sexual and gender-based violence. In contrast, globally, women live longer than men, particularly in industrialized countries.<sup>12</sup> Adding to the complexity in understanding the impact of gender on health is the well-described interaction of gender, class, and race.

### COMMUNITY

Social resilience is a community's capacity to respond to challenges. The effects of a given challenge on different communities will vary depending on their institutions, social support, social capital, built environment, and diversity. For example, disasters such as Hurricane Katrina, the Asian Tsunami, or the 1960s race riots may have had varying impacts depending on community factors such as differences in population density, prevention, management during the disaster, and postchallenge regrowth. These differences,

we posit, are due to variations in the factors delineated below.

### **Institutions**

Institutions within a community can foster resilience. For example, strong school systems, religious organizations, community improvement associations, recreation centers, and providers of healthy food are examples of institutions that can promote a resilient community fabric. Geographic accessibility of supermarkets that can provide access to fruits and vegetables,<sup>13</sup> which increase community, family, and individual resilience through improved physical health. As another example, communities that have strong mobility solutions for the handicapped can keep more of their citizens active and engaged in community life.<sup>14</sup>

### **Social support**

Social support and social integration are community-level resilience components. Strong evidence links social support to lower morbidity and mortality.<sup>15</sup> Although such improvements are often measured on an individual level, some communities foster social support and social integration by providing assistance such as Meals on Wheels or transportation to religious events and medical visits. An interesting theory, developed by Ozbay et al,<sup>16</sup> asserts that social support is essential to maintain good physical and psychological health in the presence of genetic, developmental, and other environmental risks,<sup>16</sup> providing insights into how social factors related to cellular and psychological resilience. Social support is linked to resilience in women more so than men, indicating differential gender resilience processes. In addition, as women live longer than men and with more years of disability, they are more dependent on community social support vehicles.

### **Social capital**

Social capital includes the features of a social organization that facilitate cooperation for the common benefit, for example, social trust and civic participation. Examples of individual health benefits from greater community-level social capital are reduced odds of poor health and days of activity limitation.<sup>17</sup> Communities with higher social capital have lower recurrence of acute coronary syndromes among posthospitalized lower-income adults than do communities with lower social capital.<sup>18</sup> Community interventions such as extension of communal microcredit, communal water projects in arid regions, and waste management projects can increase social capital. Globally, nurses have recently examined community interventions to increase social capital, as well as recognizing gender differences implicated in these interventions.<sup>19</sup>

### **Built environment**

The built environment, that is, person-made physical structures and infrastructures, impacts resilience. Zoning laws, transportation networks, land use policy, sidewalks, and parks can be conducive to resilience-promoting exercise, gatherings, and social capital. These environmental capacities have differing implications depending on whether the setting is rural, urban, or suburban. Scientists are beginning to focus on built environments that promote activity, nutrition, and accessible outdoor spaces. Each of these efforts can in turn foster a more resilient community composed of increasingly resilient individuals. Examples of strong community focus include ground lead removal, rubberized jogging trails, and community gardens, as well as housing quality.

### **Diversity**

Resilient communities have opportunities for diverse collections of people. Just as resilient environments thrive under circumstances of eco-diversity, diverse collections of

people strengthen the resilience and health of a community. Although little, if any, research has focused on whether nondiverse collections of people strengthen a community's resilience and health, it is certainly the case that racial segregation harms human health. Racial health disparities in the United States are in large part caused by continuing racial segregation,<sup>20</sup> which is associated with increased risk for illness or death. Concentration of economic and social disadvantage reduces the ability of individuals and families to access the kind of community resources and social capital that are available in communities with economic diversity.

## **FAMILY**

A family is a group of individuals who are bonded through genetics, cohabitation, or affinity. Families provide essential components for optimal physical and emotional development for children and support for elderly or infirm family members. The original function of families was provision of resources to children and protection from physical threats in the environment. Families also shape children's worldview through modeling behaviors, which provide a sense of morality and inform gender roles. Families also expose children to opportunities to learn and develop. Families continue to evolve as society changes. As such, family structure and function differ greatly among cultures. Therefore, we discuss some of the key functions of family with a focus on how it shapes the child, but acknowledge that families are diverse and provide support that varies over the individual's lifetime.

### **Developmental opportunities**

Parenting practices play a key role in the healthy development of children by preserving the child's perception of life as safe, secure, and predictable, even in adverse circumstances. Parenting can provide a protective environment that helps children develop skills to meet the emotional, intellec-

tual, and physical demands of community and society, which themselves promote optimal adult functioning. Children exposed to parental nurturing and environmental stimulation exhibit better memory performance and a larger vocabulary than those who experience less nurturing and stimulating environments.<sup>21</sup>

### **Behavior modeling**

The modeling of resilient attitudes and behavior by parents influences children's resilient potential. Positive parenting, including effective modeling of appropriate coping strategies, results in fewer behavioral problems in children.<sup>22</sup> Parents also model behavior toward others outside the family. Modeling civility, empathy, and volunteerism can also increase children's ability to engage positively in their community.<sup>23</sup>

### **Connectedness**

Children feel connected when parents or supportive adults communicate comfort, respect for the child, and ability to adapt to the needs of the child. A landmark longitudinal study of high-risk children found that the existence of at least 1 supportive adult fostered resilience by protecting against social and emotional risks.<sup>24</sup> In a sample of adolescents following an earthquake, both connectedness to family as well as support from their community resulted independently to resilience, providing evidence of the need to integrate community and family level interventions to foster resilience.<sup>25</sup>

### **Sense of safety and security**

Developing children need to know that they and their parents can manage their daily environment to ensure safety and security. Young children use information conveyed by adults to interpret their security and the family's ability to conquer a challenge. For example, young Iraqi children exposed to the combat of the Gulf War were only at risk for



anxiety symptoms if their mother reported anxiety symptoms.<sup>26</sup>

## INDIVIDUAL

Each individual perceives the world and their role in it through a unique perspective, and this perspective contributes to the individual's resilient potential. Some of the many individual differences that shape this perspective include view of self, sense of purpose, coping strategies, sex, spirituality, and race. Many of these factors are innate, or formed early in life (such as personality- and trait-based emotional regulation). Innate traits are important to understand from a resilience perspective because improved preventive efforts may be developed to target those at greatest risk to mitigate negative outcomes. Most resilience theory and research has been at this whole-individual or personality level; this level is essential to promote holistic nursing practice.

### View of self

An individual's view of self is related to how he or she faces challenges. This view of self is made up of many interrelated factors including sense of worth, perceived ability to overcome challenges, and perceived locus of control. Although these vary by individual, there are also gendered patterns in view of self and its resilience implications. Greater perceived ability to cope with stress and higher self-esteem are independently associated with psychological resilience in traumatized individuals,<sup>27</sup> and are shaped by family and cultural gender ideals.<sup>28</sup>

### View of world

Positive worldviews foster resilience. Positive affect (eg, emotional well-being, positive mood, joy, happiness, vigor, energy) and positive trait-like dispositions (eg, life satisfaction, hopefulness, optimism, sense of humor) are associated with reduced mortality.<sup>29</sup> Optimism is the most studied positive emo-

tion and reflects an ability to experience positive emotions even when a negative event occurs, that is, to maintain positive beliefs about the world. Having an optimistic worldview could further a resilient response to uncontrollable world events, or foster the ability to find meaning in stressful life events. High levels of optimism have been linked to reduced risk for cardiovascular death.<sup>30</sup> A sense of purpose reflects that the individual feels there is a benefit to belonging in society; a strong sense of purpose is linked to resilience following a challenge.

### Coping strategies

Coping strategies are cognitive and behavioral strategies individuals use to manage the environment and its challenges. Selection of coping strategies involves individuals' perceptions of potential harm from the stressor and beliefs in capability to handle the challenge, as well as their view of the world. Adaptive coping methods can include elicitation of emotional social support, use of humor, acceptance, sharing feelings with a close friend or relative, planning, use of religion, or distraction, among others. Adaptive coping strategies are associated with recovery from challenges as diverse as myocardial infarctions, traumatic events, cancer symptoms, depression, and postcombat reentry to society.<sup>31</sup>

### Spirituality

Religion and spirituality provide a framework within which individuals can understand adversity and manage psychological distress. High religious involvement and perceived spirituality are associated with reduced rates of mortality.<sup>32</sup> More women than men use spiritual coping methods to facilitate resilience, indicating that gender needs to be considered when implementing spiritual interventions.

### Sex

The sex-based mechanisms of resilience may be genetic, hormonal, or environmental.

These 3 contributors to differential resilience can be difficult to separate as they almost universally co-occur. Although some biological differences are clearly due to sex-specific mechanisms, an interaction of these mechanisms with gender and other nonbiological variables may also contribute to outcomes. For example, in a large prospective study, coronary heart disease risk for females but not males related to females' low perceived ability to control their home environment.<sup>33</sup> Around the world, survival rates are higher among female than male infants during the first year of life. Therefore, sex is an important biological resilience variable but incompletely understood due to its almost universal overlap with differential hormones and environmental experiences.

### **Race**

In the United States, as in other predominantly Caucasian countries with "minority" races, it is advantageous to be Caucasian. Because there is more intrarace than inter-race variability, race is not a useful biologic or genetic category to examine racial differences in resilience. However, wide racial disparities in health exist because living as a Caucasian or African American has important health implications through differences in education, neighborhoods, jobs, health care, income, and wealth.<sup>34</sup> Despite consistent health disparities by race, African Americans are less likely than Caucasians to commit suicide. Positive racial identity is a protective factor in which a sense of self is embedded in the African American collective identity.<sup>35</sup> This sense of self may buffer the physiologic effects of oppression and differential access to resources experienced by African Americans with respect to some outcomes, for example, lower rates of suicide than Caucasians.

### **PHYSIOLOGICAL**

Essential aspects of traditional nursing practice support physiologic resilience through multilevel interventions such as

medication management, health-behavior counseling (eg, smoking cessation, diet, and exercise), and increasing family and social support. In other literatures, resilience to challenge is often framed primarily at the physiologic level. An acute challenge triggers the stress response including the hypothalamic pituitary adrenal axis (HPA), the sympathetic nervous system (SNS), and monoamines and neuropeptides within the brain. These result in mobilization of the body's energy stores, immune system, mood, behavior, and memory of the challenging environment.<sup>36</sup> However, when a stressor is chronic there is an adaptation in the response to moderate potential damage of excessive activation, and this adaptation is shaped by previous challenges, as well as the developmental age of the individual.<sup>3</sup>

### **Neurochemical activity**

Neurons synthesize and release neurochemicals such as monoamines and neuropeptides following challenge, and it is the balance of these neurochemicals that facilitate resilience. For example, high levels of neuropeptide Y (NPY) reduce anxiety symptoms in soldiers undergoing high-stress training,<sup>37</sup> and high levels of brain derived neurotrophic factor (BDNF) mitigate the stress-induced neuronal morphology changes that increase risk for psychiatric symptoms.<sup>38</sup> Serotonin has stress-mitigating properties, and increases in its activity improve anxiety, depression, pain, and health perception.

### **Hormone balance**

Hormonal balance is an integral element of physiologic resilience and is influenced by multiple factors. These factors include sex, past experiences, and the nature of the challenge. Hormonal balance fosters neuronal protection and preservation of functioning in cells, tissues, and organs,<sup>36</sup> and may contribute to observed differences between men and women. In men, history of androgen deficiency is associated with the onset of

Alzheimer's disorder,<sup>39</sup> whereas androgen increases are linked to risk for hypertension. There is still much research needed to understand these interactions between sex, hormones, and experience.

### **Glucose regulation**

Glucose regulation is a key aspect of energy management related to resilience. Chronic challenges can alter glucose regulation, resulting in greater risk for obesity, metabolic syndrome, and type II diabetes.<sup>40</sup> Interestingly, glucose dysregulation can be reversed in individuals who receive an intervention to foster psychological resilience.<sup>41</sup>

### **Inflammation**

The inflammatory response is an innate immune function and is essential for physiologic resilience. It comprises the balance of inflammatory actions and immunological memory that fosters resilience. There are complex connections between cognitive memory, environmental stressors, endocrine and hormonal axes, and immunological memory, resulting in an ability to efficiently cope with stressful episodes and balance immune function.<sup>42</sup>

## **CELLULAR**

Even cells have resilience mechanisms that adapt to challenge. Each cell adapts to changes in the environment through altering proteins, RNA activity, and DNA accessibility. When DNA is damaged by free radicals or other processes, it must be repaired or no longer transcribed. DNA damage results in changed protein production as well as changes to the structure and function of the cell. These changes contribute to resilience or risk.

### **Genetic inheritance**

A portion of the ways that cells repair and use their DNA is related to genetic inheritance. Another portion is related to

gene x environment interactions. For example, the serotonin transporter promoter polymorphism (5HTTLPR) is associated with psychological resilience.<sup>43</sup> Therefore, underlying DNA inheritance may contribute to resilience. We are just beginning to understand that nurses can affect genetic expression through intervening on the "environment" aspect of the gene x environment interactions.

### **Epigenetics**

Epigenetics refer to changes in individuals' phenotype independent of genotype. These changes occur through mechanisms such as histone modification, which alters the accessibility of genes for transcription. The resulting transcription modifications and protein production result from factors such as environmental challenges and the sex of the individual. Epigenetic changes modify psychological and physiological responses to challenges and resilient capacity, and can foster resilience through protection from cancer, recovery from ischemic injury, and increased neuronal plasticity.<sup>44</sup>

### **DNA repair**

DNA nucleotides form a complex structure with damage-prone weak bonds. The capacity to effectively repair DNA varies by individual and becomes increasingly important with age. DNA repair genes recognize and remove some of the 5000 DNA lesions that occur. Sex and stress hormones influence DNA repair, possibly contributing to more longevity in women. The change mechanisms that result in resilience following challenge that require additional investigation.

### **Oxidative stress**

The body's use of oxygen creates byproducts, which damage cell components, including DNA. The human body constantly makes these byproducts, or reactive oxygen species (ROS), and absorbs them. Oxidative stress occurs when the ROS overwhelm the mechanisms to absorb them. Individuals vary in

their efficiency at keeping oxidation in balance; these variations may result from endogenous factors such as mitochondrial respiration, lipid peroxidation, and phagocytosis; and exogenous factors including smoking, environmental toxins, radiation, and psychological stress.<sup>45</sup> Exercise and antioxidant food but not stand-alone vitamins<sup>46</sup> decrease ROS.

### **Mitochondrial function**

Mitochondria generate cells' chemical energy and participate in cell signaling, cellular differentiation, cell death, cell cycle control, and cell growth. Adequate functioning of mitochondria is a key component of cellular resilience, and can mitigate the effects of chronic stress and injury. For example, in animal models of stress, sufficient mitochondrial function protects against neuronal destruction.<sup>47</sup>

### **Nuclear Factor Kappa-Light-Chain-Enhancer of Activated B Cells**

NF- $\kappa$ B (nuclear factor kappa-light-chain-enhancer of activated B cells) is a protein complex that acts as a gene transcription factor. NF- $\kappa$ B is found in almost all mammalian cell types and is involved in cellular responses to stimuli such as stress, cytokines, free radicals, ultraviolet irradiation, oxidized LDL, and bacterial or viral antigens. Sufficient regulation of NF- $\kappa$ B is linked to decreased incidence of cancer, inflammatory and autoimmune diseases, septic shock, viral infection, and proper immune development. NF- $\kappa$ B has also been implicated in synaptic plasticity and memory, with higher levels of NF- $\kappa$ B resulting in greater ability to positively adapt to change and to mitigate the onset of emotional problems.<sup>48</sup>

### **Cellular senescence**

Cells eventually lose the ability to divide, which results in death or senescence of the cell. Cellular senescence contributes to age-related reductions in total cell populations,

an effect partly related to mitochondrial function and increases in cardiovascular-related death.<sup>49</sup> Telomeres are repetitive DNA sequences at the end of a chromosome, which protect the cell from senescence. A reduction in telomere length is consistently linked to high levels of perceived stress and increased mortality risk.<sup>50</sup>

### **Summary of nursing research and practice implications**

The essential component of nursing care is a focus on the holistic nature of the person, and the recognition that they are engaged in constant adaptation to their environment. The theory we present recognizes the holistic view of the individual that nurses often already use in practice and delineates the factors, from macro to micro levels, that promote research and interventions that facilitate resilience. In the society-to-cells model of resilience we propose that it is the essential of nursing practice to recognize the individual as part of a dynamic system that is in constant change. It is therefore the role of the nurse to identify factors that detract from resilience capacity, not only in individuals, but also their families, communities and societies. Therefore, we propose that it is the role of nurses to foster resilience through actions that involve all 6 levels of our theory and that nursing interventions that incorporate changes at multiple levels will result in the most powerful and long-lasting change. We also propose that it is the nature of nursing to view variables in individuals, families, communities, and societies integrative and to design collaborative interventions that will promote sustainable and equitable resilience. Interventions must be based on this perspective and nursing interventions are not limited to individual patient care, but also extend to policy changes that impact the individual through societal and community change.

More specific nursing research implications of our theory are that nurse researchers can design interventions that target multiple

levels and which, we hypothesize, will result in the ability to produce more lasting change. For example, we predict that an exercise intervention that provides education, problem solving, family support, and built environment modification is more likely to result in lasting change than an intervention that focuses solely on education. This comprehensive approach has important implications for designing interventions that work at multiple levels, and have the ability to result in lasting change. Multilevel interventions may also transmit change from an impacted individual or community to others because a more resilient individual or community is more likely to foster resilience in others. Lastly, another implication of examining multiple levels for nursing research is to better determine the effects of modifiers and consider multilevel modeling because variables on many levels can affect the outcomes of interest. This theory may lead to refinement of current methods to address these methodological issues, or initiate the development of additional methods to better understand the complex relationships among variables that influence health.

By providing a framework in which nurses can foster resilience at any of these levels, our theory may prove useful in the classroom, in clinical practice, and in designing and testing novel interventions, as well as in linking diverse areas of research to further nursing science. Nursing research that addresses the complexity of these connections validates

holistic nursing practice and provides opportunities to address research questions in ways that few other disciplines are not able to accomplish. By connecting what appear to be diverse topics, nurse researchers who use different methods may be able to converse about commonalities of research questions. This dialogue may facilitate more comprehensive programs of nursing research.

The society-to-cells theory of resilience also provides a framework to better understand, the nature of individual as well as group difference in outcomes. In this article, we highlight the fact that gender, race, and socioeconomic differences can result in greater risk, but also that recognizing these differences provides an opportunity to use them as strengths. For example, although living as an African American in the United States increases many health and social risks, a positive racial identity is a protective factor for health. By acknowledging the aspects of individual differences that can increase resilience, nurses have an opportunity to promote resilience in all individuals.

Next steps include the development of research and policy initiatives to strengthen resilient capacities at each level. It is our hope that this theory will promote research that links concepts across disciplines, and poses questions that incorporate diverse methods and expertise. This research may spur interventions that result in sustained resilience in individuals, communities, and societies based on the principles of interconnection described in this theory.

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