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# Medical Fitness and Resilience

## A Review of Relevant Constructs, Measures, and Links to Well-Being

Regina A. Shih, Sarah O. Meadows, Margret T. Martin

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RAND Project AIR FORCE

Prepared for the United States Air Force  
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## Preface

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U.S. military personnel have been engaged in operations in Central Asia and the Middle East for the past decade. Members of the armed forces also deploy to other regions of the world. Many aspects of deployments have the potential to contribute to individual stress, such as uncertainty about deployment time lines; culture shock in theater; fear of or confrontation with death or physical injury; environmental challenges, such as extreme climates and geographical features; austere living conditions; separation from friends and family members; and reintegration after deployment. Service members and their families also manage other military-related stressors, such as frequent relocations, long work hours, and the additional family separations associated with unaccompanied tours and domestic training exercises. Some service members and their families may cope well or even thrive as they overcome adversity and accomplish challenging tasks. However, some may suffer negative consequences as a result of military-related stressors, such as physical injury, including traumatic brain injury; depression, anxiety, or other mood disorders; post-traumatic stress disorder; spiritual crises; substance abuse; family dysfunction; marital problems and dissolutions; social isolation; and, in extreme cases, even suicide or suicide attempts. With the aim of preventing such deleterious outcomes rather than simply responding to them, the study of resilience is of paramount importance.

The Air Force offices of Airman and Family Services (AF/AIS), the Surgeon General (AF/SG), and the Secretary of the Air Force, Force Management and Personnel (SAF/MRM) asked the RAND Corporation to help the Air Force develop its programs to promote resiliency among military and civilian Air Force personnel and their families. This report is one in a series of nine reports that resulted from that research effort.

The overarching report, *Airman and Family Resilience: Lessons from the Scientific Literature* (Meadows and Miller, forthcoming), provides an introduction to resilience concepts and research, documents established and emerging Air Force resiliency efforts, and reviews the Air Force metrics for tracking the resiliency of Air Force personnel and their families. It also provides recommendations to support the development of resilience initiatives across the Air Force. We use the term *resilience* to refer to the ability to withstand, recover from, and grow in the face of stressors and *fitness*, which is related, as a “state of adaptation in balance with the conditions at hand” (Mullen, 2010).

Accompanying that overarching report are eight supplemental reports that outline the constructs, metrics, and influential factors relevant to resiliency across the eight domains of Total Force Fitness:

- medical
- nutritional
- environmental
- physical
- social
- spiritual
- behavioral
- psychological.

These supplemental reports are not intended to be a comprehensive review of the entire literature within a domain. Rather, they focus on studies that consider the stress-buffering aspects of each domain, regardless of whether the term *resilience* is specifically used. This expanded the scope of the reviews to include a broader range of applicable studies and also allowed for terminology differences that occur across different disciplines (e.g., stress management, hardiness).

In this report, we identify key constructs relevant to medical fitness from the scientific literature. These constructs address preventive care, the presence and management of injuries and chronic conditions, and facilitators and barriers to accessing appropriate quality health care. It provides a general discussion of how the four constructs are related to resilience and fitness. Both terms can be measured by such factors as the ability to cope with stress, work productivity, psychological health, and risk for suicide ideation and attempts. We also review interventions designed to promote those medical fitness constructs, focusing generally on preventive care interventions as one of the most promising ways to reduce the prevalence and burden associated with medical conditions and injuries.

Health care providers and clinicians have established methods to address each of the four constructs of medical fitness. This report does not focus on measures to screen, detect, or manage the gamut of medical conditions. Rather, it more broadly addresses each construct and delves more deeply into some of the more common medical conditions among Airmen and their families.

The results of these reports should be relevant to Air Force leaders who are tasked with monitoring and supporting the well-being of active duty, reserve, and guard Airmen, and Air Force civilian personnel, as well as their families. The results of our studies may also help broaden the scope of research on resilience and help Airmen and their families achieve optimal medical fitness.

The research described in this report was conducted within the Manpower, Personnel, and Training Program of RAND Project AIR FORCE as part of a fiscal year 2011 study titled “Program and Facility Support for Air Force Personnel and Family Resiliency.”

## RAND Project AIR FORCE

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# Contents

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Preface.....	iii
Figures.....	ix
Summary.....	xi
Acknowledgments.....	xiii
Abbreviations.....	xv
1. The Context of This Report.....	1
2. Introduction.....	5
3. Preventive Screenings.....	9
General Preventive Screenings for Civilians.....	9
General Preventive Screenings for the Air Force.....	11
Immunizations.....	12
Immunizations Within the Air Force.....	13
Hearing Screenings.....	13
Hearing Screenings Within the Air Force.....	14
Vision Screenings.....	14
Dental Screenings.....	14
Dental Screenings Within the Air Force.....	15
Summary.....	15
4. Facilitators and Barriers to Accessing Appropriate Quality Health Care.....	17
Factors Related to Access and Use of Health Services.....	17
Summary.....	20
5. The Presence and Management of Chronic Conditions.....	21
Obesity.....	23
Diabetes.....	25
Asthma.....	27
Summary.....	28
6. The Presence and Management of Injuries.....	29
Traumatic Injury.....	30
Traumatic Brain Injury.....	31

Chronic Pain.....	34
Summary .....	36
7. Interventions to Promote Medical Fitness .....	37
Health Behaviors.....	38
Tobacco Use.....	38
Physical Activity .....	39
Diet and Nutrition .....	40
Technology.....	40
Worksite Health and Wellness Programs.....	42
Summary .....	44
8. Conclusion .....	45
Bibliography .....	47

## Figures

---

2.1. Main (or Direct) Effect of Resilience on Well-Being.....	6
2.2. Buffering (or Direct) Effect of Resilience on Well-Being.....	7



## Summary

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Medical fitness can be defined as medical readiness to perform duties under all conditions without excessive loss of quality of life, excessive loss of duty time or separation from duty, aggravation of existing medical conditions, or endangering the health of others. Being medically fit is important, because if an individual has a chronic medical condition or is otherwise physically or medically compromised, he or she may not be able to effectively cope with a stressor. Measures of medical fitness can be grouped into four broad categories: preventive care; the presence and management of injuries; the presence and management of common chronic conditions, including obesity, diabetes, and asthma; and facilitators of and barriers to accessing quality health care.

Engaging in preventive screenings, such as regular dental, hearing, and vision exams, as well as receiving immunizations and cancer screenings, has been shown to reduce the risk for and severity of such diseases as cancer, cardiovascular disease, obesity, infectious diseases, metabolic and endocrine conditions, and obstetric and gynecologic conditions.

Traumatic injury to the body and brain and injury-related chronic pain are debilitating and can seriously compromise resilience. These conditions are related to discharge from the military, long-term loss of productivity, psychological symptoms, increased drug and alcohol use, lower general health, lower quality of life, and risk for suicide. The use of measures to screen for and detect injuries and to assess ability to cope with pain, and the proper medical management of symptoms in combination with supportive therapy and social support systems, are key to mitigating the effects of injuries on military readiness.

The presence of common chronic conditions, such as obesity, cardiovascular conditions, diabetes, and asthma, has been linked to loss of productivity, psychological symptoms, substance use, suicide ideation/attempts, and risk for other medical conditions, such as stroke, hypertension, arthritis, chronic pain, respiratory conditions, and cancer. The presence of conditions is measured by a physician's diagnosis, by self-reports, or through administrative data. The effective management of medical conditions is often assessed via the Healthcare Effectiveness Data and Information Set (HEDIS) and patient experiences are measured by the Agency for Healthcare Research and Quality's Consumer Assessment of Healthcare Providers and Systems program. Preventing these chronic conditions through behavior modification and properly treating them are all ways to improve medical fitness. Once a diagnosis has been received, adherence to treatment regimens specific to each condition is paramount to reducing both the severity of the condition and the effect on readiness.

Of course, each component of medical fitness outlined above falls within a greater context of access to quality health care. Facilitators of accessing health care include having health insurance, having a usual source of care, and patient perception of the need for services. Although service members and their families have equal access to health care, barriers to seeking health care remain, because of such factors as the perceived stigma of using health care services and low social support.

Interventions that promote regular preventive care, encourage positive health behaviors, and curb negative health behaviors may be particularly effective at staving off medical conditions that can compromise resiliency and military readiness. Given technological advances and the burden of traveling in person to Health and Wellness Centers, recent research on the administration of these interventions through telephone, mobile text messaging, the Internet, and worksite health and wellness programs (HWPs) has shown strong promise in terms of feasibility and efficacy.

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RAND's Sarah Meadows and Laura Miller led the overall research effort on resilience and provided extensive feedback on a previous draft of this manuscript. Lopamudra Das provided research assistance for this report. Donna White and Hosay Salam Yaqub provided valuable assistance formatting the manuscript and assembling the bibliography. We also thank the two reviewers, Joie Acosta and Mark Friedberg, who provided critical feedback on the report.



## Abbreviations

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ACIP	Advisory Committee on Immunization Practices
ACOG	American Congress of Obstetricians and Gynecologists
ADA	American Dental Association
AHRQ	Agency for Healthcare Research and Quality
AIS	Abbreviated Injury Scale
AMA	American Medical Association
AP	Anatomic Profile
BMI	body mass index
CDC	Centers for Disease Control and Prevention
COPD	chronic obstructive pulmonary disease
DCOE	Defense Centers of Excellence
DoD	Department of Defense
GCS	Glasgow Coma Scale
HAWC	Health and Wellness Center
HEDIS	Healthcare Effectiveness Data and Information Set
HRA	health risk assessment
HWP	health and wellness program
ISS	Injury Severity Score
NIH	National Institutes of Health
NINDS	National Institute of Neurological Disorders and Stroke
NISS	New Injury Severity Score
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
OIS	Organ Injury Scale
PAF	Project AIR FORCE
PHA	periodic health assessment
PHE	periodic health examination
PTSD	post-traumatic stress disorder
ROI	return on investment
SES	socioeconomic status
SF-36	Short-Form 36 Questionnaire
SMS	short message service (mobile phone)
TBI	traumatic brain injury

TdAP	tetanus-diphtheria and acellular pertussis
TFF	Total Force Fitness
TRISS	Trauma and Injury Severity Score
VA	The U.S. Department of Veterans Affairs
VHA	Veterans Health Administration
WHO	World Health Organization

# 1. The Context of This Report<sup>1</sup>

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This report is one of a series designed to support Air Force leaders in promoting resilience among Airmen, its civilian employees, and Air Force family members. The research sponsors requested that RAND assess the current resilience-related constructs and measures in the scientific literature and report any evidence of initiatives that promote resilience across a number of domains. We did not limit our search to research conducted in military settings or with military personnel, as Air Force leaders sought the potential opportunity to apply the results of these studies to a population that had not yet been addressed (i.e., Airmen). Further, many Air Force services support Air Force civilians and family members, and thus the results of civilian studies would apply to these populations.

This study adopts the Air Force definition of resilience: “the ability to withstand, recover and/or grow in the face of stressors and changing demands,” which we found to encompass a range of definitions of resilience given throughout the scientific literature.<sup>2</sup> By focusing on resilience, the armed forces aim to expand their care to ensure the well-being of military personnel and their families through preventive measures and not by just treating members after they begin to experience negative outcomes (e.g., depression, anxiety, insomnia, substance abuse, post-traumatic stress disorder, or suicidal ideation).

Admiral Michael Mullen, Chairman of the Joint Chiefs of Staff from 2007 to 2011, outlined the concept of Total Force Fitness (TFF) in a special issue of the journal *Military Medicine*: “A total force that has achieved total fitness is healthy, ready, and resilient; capable of meeting challenges and surviving threats” (Mullen, 2010, p. 1). This notion of “fitness” is directly related to the concept of resilience. The same issue of *Military Medicine* also reflected the collective effort of scholars, health professionals, and military personnel, who outlined eight domains of TFF: medical, nutritional, environmental, physical, social, spiritual, behavioral, and psychological. This framework expands on the traditional conceptualization of resilience by looking beyond the psychological realm to also emphasize the mind-body connection and the interdependence of each of the eight domains.

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<sup>1</sup> Adapted from Meadows and Miller, forthcoming.

<sup>2</sup> The Air Force adopted this definition, which was developed by the Defense Centers of Excellence for Psychological Health and Traumatic Brain Injury (DCoE, 2011).

The research sponsors requested that RAND adopt the eight fitness domains as the organizing framework for our literature review. We followed this general framework, although in some cases we adapted the scope of a domain to better reflect the relevant research. Thus, this study resulted in eight reports, each focusing on resilience-related research in one of the TFF domains, but we note that not all of these domains are mutually exclusive. These eight reports define each domain and address the following interrelated topics:

- medical: preventive care, the presence and management of injuries, chronic conditions, and barriers and bridges to accessing appropriate quality health care (Shih, Meadows, and Martin, 2013)
- nutritional: food intake, dietary patterns and behavior, and the food environment (Flórez, Shih, and Martin, forthcoming)
- environmental: environmental stressors and potential workplace injuries and preventive and protective factors (Shih, Meadows, Mendeloff, and Bowling, forthcoming)
- physical: physical activity and fitness (Robson, 2013)
- social: social fitness and social support from family, friends, coworkers/unit members, neighbors, and cyber communities (McGene, 2013)
- spiritual: spiritual worldview, personal religious or spiritual practices and rituals, support from a spiritual community, and spiritual coping (Yeung and Martin, 2013)
- behavioral: health behaviors related to sleep and to drug, alcohol, and tobacco use (Robson and Salcedo, forthcoming)
- psychological: self-regulation, positive and negative affect, perceived control, self-efficacy, self-esteem, optimism, adaptability, self-awareness, and emotional intelligence (Robson, forthcoming).

These reports are not intended to be comprehensive reviews of the entire literature within a domain. Rather, they focus on those studies that consider the stress-buffering aspects of each domain, regardless of whether the term *resilience* is specifically used. This expanded the scope of the reviews to include a broader range of studies and also allowed for differences in the terminology used across different disciplines (e.g., stress management, hardiness). We sought evidence both on the main effects of resilience factors in each domain (i.e., those that promote general well-being) and on the indirect or interactive effects (i.e., those that buffer the negative effects of stress).

Because the Air Force commissioned this research to specifically address individuals' capacity to be resilient, and thus their well-being, our reports do not address whether or how fitness in each of the eight TFF domains could be linked to other outcomes of interest to the military, such as performance, military discipline, unit readiness, personnel costs, attrition, or retention. Those worthy topics were beyond the scope of this project.

Some other important parameters shaped this literature review. First, across the study, we focused on research from the past decade, although older studies are included, particularly landmark studies that still define the research landscape or where a particular line of inquiry has been dormant in recent years. Second, we prioritized research on adults in the United States. Research on children was included where particularly germane (e.g., in discussions of family as a form of social support), and, occasionally, research on adults in other Western nations is referenced or subsumed within a larger study. Research on elderly populations was generally excluded. Third, we prioritized literature reviews, meta-analyses, and ongoing bodies of research over more singular smaller-scale studies.

The search for evidence on ways to promote resilience in each domain included both actions that individuals could take and actions that organizations could take, such as information campaigns, policies, directives, programs, initiatives, facilities, or other resources. We did not filter out evidence related to Air Force practices already under way, as the Air Force was interested both in research related to existing practices and in research that might suggest new paths for promoting resilience. Our aim was not to collect examples of creative or promising initiatives at large but to seek scholarly publications assessing the stress-buffering capacity of initiatives. Thus, in general, this collection of reviews does not address initiatives that have not yet been evaluated for their effect.

Building on the foundation of the eight reports that assess the scientific literature in each domain, RAND prepared an overarching report that brings together the highlights of these reviews and examines their relevance to current Air Force metrics and programs. That ninth report, *Airman and Family Resilience: Lessons from the Scientific Literature*, provides a more in-depth introduction to resilience concepts and research, presents our model of the relationship between resilience and TFF, documents established and emerging Air Force resiliency efforts, and reviews the Air Force metrics for tracking the resiliency of Air Force personnel and their families. By comparing the information we found in the research literature to Air Force practices, we were able to provide recommendations to support the development of initiatives to promote resilience across the Air Force. Although the overview report contains Air Force-specific recommendations that take into account all eight domains and existing Air Force practices, some are applicable to the military more generally and are highlighted at the end of this report.



## 2. Introduction

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“It is a wise man’s part, rather to avoid sickness, than to wish for medicines.”  
— Thomas More, Philosopher

Medical fitness, along with the physical, nutritional, and environmental fitness domains, reflects overall body fitness and complements the spiritual, psychological, social, and behavioral components of fitness of the mind. Using the definition in the special issue of *Military Medicine* on Total Force Fitness, medical fitness for Airmen, their families, and Air Force civilians entails being free of any medical condition or predisposition and being medically ready (where readiness is capability of being able to accomplish a task [Mullen, 2010]) to perform duties under all conditions without excessive loss of quality of life, excessive loss of duty time or separation from duty, aggravation of existing medical conditions, or endangering the health of others. For family members, medical fitness also includes a state of medical health that supports the service member’s mission and the well-being of the family unit.

Medical fitness is particularly important because it can serve as a moderating factor in the resilience model presented in the overarching report of this report series (Meadows and Miller, forthcoming). Stress produces a physiological response in the body (Viamontes and Nemeroff, 2009). If an individual has a chronic medical condition or is otherwise physically or medically compromised, he or she may not be able to effectively cope with a stressor. Individuals who are not medically fit may be more likely to have a negative response to stress, given their inability to regulate the physiological consequences of stress and strain. Medical fitness, therefore, can be thought of as a tool with which to buffer stress, and lack of medical fitness can be an aggravating factor that makes it harder to cope with stress.

The goals of this report are to outline medical fitness, describe metrics of medical fitness, and discuss interventions that bolster medical fitness. Although the Air Force does provide some metrics (Winkenwerder, 2003) to determine individual medical readiness (Loftus, 2006), we expand on these metrics to include

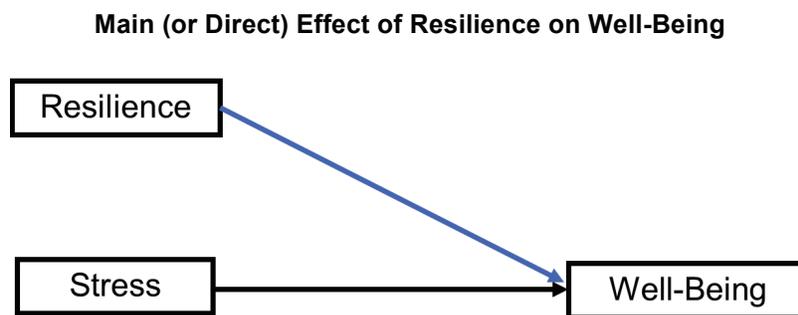
- preventive care including immunizations and screening for hearing, vision, and dental problems (Chapter 3)
- facilitators and barriers to accessing appropriate, quality health care (Chapter 4)

- the presence and management of chronic conditions (Chapter 5)
- the presence and management of injuries (Chapter 6).<sup>1</sup>

To inform the literature review to identify metrics of medical fitness, we followed an overarching conceptual framework as depicted in Figures 1.3 and 1.4 in the overarching report by Meadows and Miller (forthcoming). The first figure, which is reproduced below (Figure 2.1), depicts a main effect of a resilience factor (shown by the blue line). This association does not depend on whether a stressor is present. Experiencing a stressor also has an independent, direct effect on mental health (shown by the black line). In this model, it is not necessary to know whether an individual has experienced a stressor to assess whether the resilience factor has an effect on well-being.

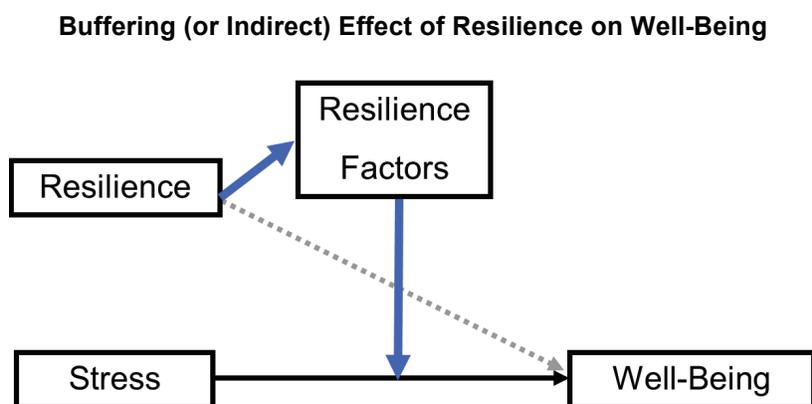
In Figure 2.2, resilience factors have only an indirect association with well-being. The stress-buffering effect can be seen when resilience resources influence well-being only in the presence of stress (shown by the blue line). In this model, it is necessary to know whether an individual has experienced a stressor to assess whether resilience and resilience factors have an effect on well-being. That is, resilience can be understood only in the context of stress. Most resilience resources have a direct effect on well-being, contribute to an individual’s overall fitness level, *and* can be used to combat stress or strain when it occurs. The key difference between resilience and fitness is that, unlike fitness, *resilience* cannot be observed outside the presence of stress.

**Figure 2.1**



<sup>1</sup> Although contagious diseases (e.g., influenza, hepatitis B) are important for determining an individual’s medical fitness, we focus on chronic conditions with long-term health consequences and chronic conditions that are found with high prevalence among Airmen, their families, and Air Force civilians.

Figure 2.2.



Therefore, we searched for evidence on both main effects (i.e., resilience factors that promote medical well-being) and indirect or interaction effects (i.e., medical fitness factors that buffer the negative effects of stress on well-being).

Our literature review of the metrics of medical fitness and interventions to promote medical fitness was not systematic. Nevertheless, we did follow similar steps to a systematic review. We first identified several key questions that resulted in a list of search terms. These included such key questions as: “What medical conditions contribute to poor well-being in service members?” or “What policies or programs help service members cope with stress associated with injuries?” These questions resulted in several groups of search terms: (1) stress, resilience, well-being (stress buffer, resilience, fitness, readiness, coping), (2) medical conditions (diabetes, obesity, asthma, traumatic brain injury), (3) programs (Air Force Instruction, Department of Defense [DoD] Directive, evidence-based programs, prevention, interventions, policies, campaign, disease management, screening, health education), and (4) terms related to the specific populations of interest (DoD, military, Air Force, service members, Airmen, children). We entered combinations of these terms into search engines such as PubMed, Web of Science, and Google Scholar.

The key questions also informed the inclusion and exclusion criteria. For example, we included studies from the past 10 years, although older, seminal studies are included. We focused our search for studies on adults and children in the United States. We did not include empirical studies conducted on fewer than 10 individuals.

In our search, we prioritized review studies and then empirical studies. To ensure that we captured as many existing studies as possible, we conducted an iterative search by examining the reference lists of all retrieved articles. In addition to searching for peer-reviewed publications, we searched for working papers and reports published by governmental and nongovernmental organizations.

We then summarized the empirical evidence gathered from the literature into four categories of medical fitness (prevention, access, and presence of chronic conditions or injuries). Within each of these categories, we describe how constructs within each category of medical fitness are measured, their relationship to measures of well-being and resiliency, and any evidence of their stress-buffering effects. For instance, in Chapter 3, we summarize our search for standards of preventive care that attempt to reduce the incidence of medical problems. Because the realm of medical conditions is so vast, we highlight diseases and medical problems that occur with high prevalence among children and young to middle-aged adults—groups that are typically represented among service members and their families. When appropriate, we also mention less common medical problems and how they may affect the ability to handle stress.

In Chapter 7, we summarize our search on interventions designed to bolster medical fitness focusing especially on behavioral interventions and various technologies that are used to promote ease of administration and access to these interventions as well as workplace health and wellness programs (HWPs).

### 3. Preventive Screenings

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Prevention of diseases or injuries is one way to improve medical fitness. Preventive medicine has three levels: primary, secondary, and tertiary. Primary preventive medicine's goal is to avoid the development of disease and includes all population-based health promotion activities (e.g., daily exercise, anti-smoking campaigns). Secondary preventive care involves detecting disease in its early stages to avoid further progression. An example of secondary prevention would be detection campaigns for certain types of cancer (e.g., colon, breast). Tertiary prevention attempts to reduce, reverse, or delay the progression of the disease and disease-related complications (Starfield et al., 2008). This chapter focuses on secondary preventive screenings to detect a disease in its early stages. As a metric of medical fitness, the use of preventive screenings can directly influence well-being (e.g., as measured by psychological or physical fitness), as depicted in Figure 2.1. Preventive screenings may also be resilience factors, as they may buffer against the effects that stress has on well-being, as depicted in Figure 2.2. This chapter discusses the scientific evidence that supports or refutes specific types of preventive screenings as being beneficial to well-being. Chapter 7 in this report on interventions describes the literature that examines primary prevention efforts. In addition, health-promotion/disease-prevention strategies are also covered with great depth in companion reports in this series, including those that relate to healthy diets in the nutritional fitness report (Flórez, Shih, and Martin, forthcoming), physical activity in the physical fitness report (Robson, 2013), and health behaviors related to positive sleep and prevention of drug, alcohol, and tobacco use (Robson and Salcedo, forthcoming).

#### General Preventive Screenings for Civilians

Although there are no gold standard metrics to measure medical readiness in terms of receipt or quality of preventive care, perhaps the most widely used set of guidelines for preventive care in civilians is the Agency for Healthcare Research and Quality (AHRQ) comprehensive guide called *The Guide to Clinical Preventive Services* (AHRQ, 2010). This guide outlines recommendations of the U.S. Preventive Services Task Force to improve preventive care that patients receive for various health conditions, such as cancer; heart, vascular, and respiratory diseases; infectious diseases; and metabolic, nutritional, and endocrine conditions. Each recommendation is accompanied by a letter grade to reflect the strength and certainty of evidence to support the provision of each preventive service.

Other recommendations from various agencies complement these AHRQ guidelines. General health screening, a common primary preventive care practice, is recommended by the National Institutes of Health (NIH) to screen for diseases, assess the risk of future medical problems, encourage a healthy lifestyle, update vaccinations, and maintain a relationship with a doctor in case of an illness. Physical exams are meant to identify health problems before they become serious, provide reassurance of positive health, and provide an opportunity for patients to communicate any health concerns to their doctor. The comprehensiveness of procedures that are covered in physical exams is at the discretion of the physician conducting the exam. Generally, physical exams assess the history of health problems, vaccination status, family history of medical problems, health behaviors, and such vital signs as blood pressure, heart rate, temperature, and respiration rate. They also include examination of general appearance, heart, lungs, abdomen, skin and extremities, nerves, muscle strength and reflexes, reproductive organs, and laboratory tests. Discussion of preventive health measures with the patient, such as screening for cancers and engaging in positive health behaviors, may also take place. The NIH currently recommends having two physical exams in one's twenties. For women and men ages 40–64, NIH recommends having a physical exam every one to five years.

Recent guidelines released by the American Congress of Obstetricians and Gynecologists (ACOG) in 2012 provided revised Pap smear guidelines recommending that women between the ages of 21 and 65 receive a Pap smear screening every three years instead of annually and recommending against screening for women older than 65 who have had adequate prior screenings and are otherwise not at high risk for cervical cancer (ACOG, 2012).

The American Medical Association (AMA) provides specific guidelines for preventive care for adolescents in its *Guide for Adolescent Preventative Services Recommendations Monograph* (AMA, 1997). These recommendations include annual preventive services visits between the ages of 11 and 21. The AMA asserts that these annual health care visits serve to provide recommendations to promote an adolescent's understanding of physical growth and psychosocial and psychosexual development, to emphasize the importance of actively managing their health care decisions, and to provide guidance about healthy diets, physical activity, responsible sexual behaviors, and avoidance of alcohol, tobacco, and use of other illicit, over-the-counter, or prescription drugs for nonmedical purposes. The AMA also recommends annual screening for a variety of health conditions among adolescents, including hypertension, risk for depressive symptoms and suicide, eating disorders, and obesity, and selective screening among at-risk adolescents (e.g., those with a family history of cardiovascular disease) to assess risk for developing hyperlipidemia and adult coronary heart disease. The AMA recommends screening sexually active adolescents for sexually transmitted diseases and

HIV; sexually active female adolescents and females age 18 or older should be screened for cervical cancer.

Traditionally, periodic health examinations (PHEs) have been a cornerstone of the discussion of preventive health care in the United States. In 1996, the U.S. Preventive Services Task Force changed its recommendations regarding annual physical exams for asymptomatic adults, stating that there was insufficient clinical evidence to support the practice (U.S. Preventive Task Force, 1996). The AMA has also changed its recommendations for an annual physical and instead recommends testing based on individual risk factors for disease. More recently, a systematic review of the literature concluded that although PHE improves the delivery of some recommended preventive services and reduces patient worry, clarification of the long-term benefits, harms, and costs is still needed (Boulware et al., 2007). Despite these recommendations, a high percentage of adults in the general population still favor an annual physical exam (Oboler et al., 2002). In addition, a 2005 survey of primary care physicians found that 88 percent performed annual exams, 94 percent of physicians agreed that annual physical exams provided time to counsel patients, 74 percent of physicians believed that annual physical improved detection of subclinical illness, and 94 percent of physicians agreed that annual physical improved patient-physician relationships (Prochazka et al., 2005). On average, men in the United States suffer from more severe chronic conditions and have higher death rates from all 15 leading causes of death (Heron, 2010; Xu et al., 2010) and die nearly seven years earlier than women. Part of this gender disparity may result because men make far fewer health care visits than women do for various health problems, from depression to physical disabilities, independent of reproductive health care visits (Galdas, Cheater, and Marshall, 2005; Bertakis, 2000; Courtenay, 2000; Kandrack, Grant, and Segall, 1991; Padesky and Hammen, 1981; Weissman and Klerman, 1977). Thus, emphasizing factors that support preventive health care-seeking behavior, especially among men, is of great importance.

## General Preventive Screenings for the Air Force

An annual periodic health assessment (PHA) is a requirement to determine individual medical readiness. The PHA provides evidence-based, cost-effective preventive health services and also serves to identify and document potential duty-limiting conditions (Green, 2012). The Air Force follows the PHA policy but does so through the Air Force Preventive Health Assessment program as required by Air Force Instruction 48-123 (Chu, 2006). The PHA includes a complete review of the medical record, health history, and results of a health survey administered by trained clinical staff at military treatment facilities. The PHA also includes screening of blood pressure, cholesterol, and cervical

cancer. The PHA specifies that Airmen have a one-on-one preventive health visit at least once every three years. The PHA business rules follow the guidance provided by the U.S. Preventive Services Task Force Guide to Clinical Preventive Screenings, which has categorized its recommendations in terms of whether a preventive service improves health outcomes and whether benefits outweigh harms in routine patient populations. The clinical preventive services business rules for the PHA are regularly updated to reflect new recommendations and evolving standards of practice (Green, 2012). In addition to the PHA, the Air Force requires predeployment and enhanced postdeployment health assessments that determine medical fitness before and after deployments.

A study of 298,549 active duty Air Force members found that although overall prevalence rates of current PHA preventive appointments were very high, non-Hispanic whites were overall less likely to have a current PHA (Hatzfeld and Gaston-Johansson, 2010). Nevertheless, although such minority groups as non-Hispanic blacks were more likely than non-Hispanic whites to participate in preventive health exams, non-Hispanic blacks and Asian Pacific Islanders had statistically significantly higher rates of being permanently medically nondeployable, regardless of age or rank. In addition, there were lower rates of having a current PHA for senior officers than for junior officers. These results demonstrate that, despite equal access to care in the Air Force, disparities in preventive care for active duty service members still exist.

## Immunizations

The Centers for Disease Control and Prevention (CDC) outlines recommendations for immunizations for both adults and children in its report, “General Recommendations on Immunizations” (CDC, 2011a). Specifically, CDC’s Advisory Committee on Immunization Practices (ACIP) (Loftus, 2006) recommends routine influenza vaccinations for all individuals over age six months (Fiore et al., 2010). A shingles or herpes zoster vaccination may be given once after age 60. A physician may recommend other immunizations, for example, if a patient is at high risk for certain conditions, such as pneumonia, or in the case of deploying Airmen who may be exposed to diseases not common in the United States.

The NIH recommends a tetanus-diphtheria and acellular pertussis (whooping cough) (TdAP) vaccine after age 19 and a tetanus-diphtheria (Td) booster every 10 years. *Guidelines for Adolescent Preventative Services (GAPS)* recommends that adolescents receive prophylactic immunizations according to ACIP (AMA, 1997). These include guidelines on Td vaccine boosters, measles-mumps-rubella, and varicella (against chicken pox).

The CDC and World Health Organization (WHO) also outline guidelines for routine immunizations and chemoprophylaxis when visiting certain countries, depending on the destination, whether time will be spent in rural areas, the time of year, and the person's age, health status, and previous immunizations. Studies have empirically shown that chemoprophylaxis and immunizations do protect against infectious diseases that may influence medical fitness. A systematic review has shown that malaria prophylaxis is effective in preventing malaria and also in maintaining force readiness (Nakato, Vivancos, and Hunter, 2007).

## Immunizations Within the Air Force

The Air Force uses the Air Force Complete Immunization Tracking Application to prepare Airmen during predeployment processing (Deployment Health Clinical Center, 2012). The Air Force monitors immunizations that are required for occupational and deployment considerations and is one of six individual medical readiness elements (Winkenwerder, 2003). Passing requirements for individual medical readiness immunizations include hepatitis A, tetanus–diphtheria, measles-mumps-rubella, hepatitis B (if series began), and influenza (once per season) (Chu, 2006). DoD and the Air Force follow the ACIP (Loftus, 2006) guidelines.

## Hearing Screenings

Among civilians, the only screening suggested by the U.S. Preventive Services Task Force is for hearing loss in all newborn infants. There is good evidence that newborn hearing screening testing is highly accurate and leads to earlier identification and treatment of infants with hearing loss (Mason and Herrmann, 1998; Nelson, Bougatsos, and Nygren, 2008). Most adults in civilian populations do not receive hearing screening as a part of their routine physical examination because of many factors, including the time constraints of adding screening to an acute care patient visit (Newman and Sandridge, 2004) and lack of organizational structure (e.g., reminders) to facilitate screening. Screening measures for hearing loss in adults by physicians can include a version of the whispered voice test, in which several numbers or words are whispered after full exhalation from behind the patient, or a variant (e.g., rubbing fingers near the ear or using a tuning fork). These tests are quick, simple, and inexpensive but are subjective and have not been standardized using robust methods. The hearing handicap inventory for the elderly-screening questionnaire can be administered, or an audioscope test can be administered (Newman and Sandridge, 2004). Both of these methods offer

excellent test characteristics, although they screen for different aspects of hearing loss (Bogardus, Yueh, and Shekelle, 2003).

## Hearing Screenings Within the Air Force

The Air Force provides Air Force Instructions for audiology exams and requirements for waivers to fly that accompany varying levels of hearing loss (Air Force Flying Physical Medical Examination Standards, 2000). However, it is unclear what procedures are in place to screen for and monitor occupational-related hearing loss or hearing loss after exposure to bomb blasts and improvised explosive devices or other traumatic events.

## Vision Screenings

For women and men ages 19–39, the NIH also recommends having an eye exam every two years. The American Academy of Ophthalmology (2011) recommends screening for general eye health problems at birth, and the American Academy of Pediatrics recommends vision screening at the earliest possible age and subsequently at regular intervals. The American Academy of Ophthalmology recommends that all infants be screened by six months to one year of age for ocular health. Vision screening should also be performed on children between three and three and one-half years of age. Further screening examinations should be done at routine school checks or after the appearance of symptoms.

The American Academy of Ophthalmology (2011) recommends that adults have at least one eye screening in their twenties and twice in their thirties. At age 40, all individuals should have a baseline eye exam, as most eye disorders begin to develop between ages 40 and 60. Subsequent screenings are likely to be determined on an individual basis with physician input. Individuals who wear contact lenses or who have diabetes or a family history of eye conditions should have more frequent screenings and should discuss the frequency with a physician or ophthalmologist.

## Dental Screenings

Regular dental exams are a key aspect of preventive health care. Dental exams serve to clean teeth, identify gum disease or bone loss, evaluate the potential for tooth decay, and provide education on proper dental hygiene. Several review studies, mostly conducted in the United Kingdom and the Netherlands, find that the relationship between frequency of routine dental examinations and patient-centered oral health outcomes, economic outcomes, or knowledge, attitudes, and behavioral changes in oral health is

inconsistent, and therefore there is insufficient evidence to either support or refute the need for six-month routine dental exams for adults or children (Mettes, 2005; Davenport et al., 2003a, 2003b). The American Dental Association (ADA, 2011) recommends brushing with an ADA-accepted fluoride toothpaste, replacing one's toothbrush every three to four months, flossing daily, eating a balanced diet, limiting between-meal snacking, and visiting a dental professional regularly for cleanings and oral exams. For women and men ages 19–39, the NIH recommends going to the dentist every year. Although the ADA suggests regular dental exams, there are no set guidelines for how frequently these should occur. The American Academy of Pediatric Dentistry suggests receiving a comprehensive dental exam every six months for infants older than 12 months, children, and adolescents (Council on Clinical Affairs, 2009).

## Dental Screenings Within the Air Force

The Air Force requires annual dental examination and classification (Loftus, 2006) as one of six individual medical readiness elements (Winkenwerder, 2003). Individual medical readiness standards for the Air Force require being either dental class 1 (current dental exam and no required dental treatment or reevaluation) or class 2 (current dental exam with required nonurgent dental treatment or reevaluation for oral conditions that are unlikely to result in dental emergencies within 12 months) (Chu, 2006).

## Summary

This chapter has reviewed key elements of preventive medical care: routine physical exams, immunizations, and hearing, vision, and dental screenings. In the civilian population, preventive services have been shown to effectively reduce the risk of diseases and the burden of such diseases as cancer, cardiovascular disease, obesity, infectious diseases, metabolic and endocrine conditions, and obstetric and gynecologic conditions. However, in general, there is no strong empirical evidence that the measures of medical fitness outlined above are linked to airman readiness (with the possible exception of immunizations).



## 4. Facilitators and Barriers to Accessing Appropriate Quality Health Care

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Barriers to appropriate, adequate, high-quality health care are factors that prevent individuals either from accessing the care they need or from receiving the level of care that is needed in terms of its quality. In contrast, facilitators to accessing care are those factors associated with adequate consumption of either the appropriate amount or quality of care. The literature on facilitators and barriers to health care is massive. In this chapter, we highlight some of the most-researched factors that can be used as metrics of medical fitness and focus primarily on the facilitator and barrier factors that the Air Force may be able to most easily address to promote well-being and resilience. We also note that “health care” can refer to either medical or psychological treatment.

Perhaps the best-known model of health care access was developed by Aday and Andersen (1974), which discusses a framework of health care access that integrates access in the context of health policy, characteristics of the health delivery system, the populations at risk, and outcomes as measured by actual use of health care services and patient satisfaction with services.

### Factors Related to Access and Use of Health Services

Recent versions of the model, such as the Behavioral Model of Health Services Use (Andersen, 1968, 1995, 2008; Andersen and Newman, 1973), build on Aday and Anderson’s model and propose that use of health services is determined by individual characteristics, contextual characteristics measured at an aggregate level, health behaviors, and outcomes as measured by health care use, perceived health, and consumer satisfaction (see Figure 2.2). The three individual characteristics include predisposing characteristics (e.g., demographic characteristics, social structure, health beliefs), enabling resources (e.g., personal and family, community), and need (e.g., perceived, evaluated). Contextual characteristics include predisposing (e.g., community age structure), enabling (e.g., health policies, supply of medical personnel), and need (environmental factors, population health indices such as mortality rates). Health behaviors in this model now include not only personal health practices and use of personal health services but also measures of health care provider behaviors when delivering medical care (patient counseling, test ordering, prescriptions, quality of communication) (Andersen, 2008).

In its 2010 report on disparities in health care, AHRQ (2011a) focuses on three facilitators/barriers to health care: having health insurance, having a usual source of care, and patient perception of the need for services. Not surprisingly, individuals without health insurance are more likely to have poor health (AHRQ, 2011a; Wilper et al., 2008). However, this potential barrier is less relevant to the military, where service members and their families are automatically covered by medical insurance.

Having a usual source of health care (other than an emergency room or department), typically a general practitioner, is also associated with better health, especially among patients suffering from chronic conditions (May, Bartman, and Weir, 1995; Mainous et al., 2004), in addition to lower spending on health care (Phillips et al., 2009). Having a usual source of care is associated with better patient-physician communication and trust, both of which have been linked to receipt of higher-quality care (Mainous et al., 2001; Inkelas et al., 2004). Patients who have a usual source of care are also more likely to receive preventive services, especially if they also have insurance (DeVoe et al., 2003; Blewett et al., 2008). Because Airmen and their families move every two to three years, it may be especially difficult to develop a usual source of care. Thus, the Air Force could address consistency in care as a potential barrier.

Having health insurance and a usual source of care could be viewed as structural impediments to health care, since they are primarily a function of the way the overall health care system is set up in the United States. However, individual preferences also play a role in whether one has access to quality care when it is needed. An individual's *perception of need* when it comes to health care can also influence whether the appropriate type and amount of care is received. These perceptions are often based on whether an individual believes that he or she is ill or injured enough to seek care and whether he or she can obtain care when it is warranted (Andersen, 1995). Perceptions of need can be influenced by a number of factors and thus may be more difficult for the Air Force to address; however, as we discuss below, stigma may be one barrier to care that may influence perception of need.

In addition to the three facilitators/barriers outlined by the AHRQ, the research literature has also highlighted a number of other individual-level factors that are associated with differential access to health care. Perhaps the factor that has received the most attention in the literature is socioeconomic status (SES), typically measured as income. Low SES is generally viewed as a barrier to health care (Kirby, 2008; Reid, Vittinghoff, and Kushel, 2008; DeVoe et al., 2007). However, other measures of SES have also been found to be barriers, including housing instability (e.g., homelessness) and food insecurity (Kushel et al., 2006).

A number of other sociodemographic factors have been implicated as barriers to care. Men are less likely to seek or receive care than women (AHRQ, 2011a; Kuehn, 2006). In

addition, racial/ethnic minorities are less likely to report receipt of care (Richardson and Norris, 2010; Scheppers et al., 2006). Not speaking English is a major barrier to care (Jacobs et al., 2006; Chang and Fortier, 1998). Finally, where an individual lives can also be considered a potential barrier to access to care. For example, individuals who live in rural settings are less likely to have adequate access than those who live in urban areas (Brems et al., 2006; Mueller et al., 1999; Schur and Franco, 1999).

Two other individual-level factors have also been associated with access to care, and they are potentially very important for Airmen, their families, and Air Force civilians. The first is social support. Individuals with strong social support networks have greater access to care (Perry et al., 2008). Specifically, individuals who felt that they could call neighbors for help in a medical emergency, could ask a neighbor for a ride to a clinic or doctor's appointment, could ask a neighbor for help in filling out forms, and who had helped friends and neighbors with small tasks within the past year were *less* likely to report barriers to health care (Perry et al., 2008). Although this study used a low-income sample, it highlights the importance of perceptions of support and a sense of community in access to health care.<sup>1</sup>

The second factor is perceived stigma. A number of recent studies have reported that perceived stigma is a barrier to receiving psychological care among veterans and soldiers in theater (Ouimette et al., 2011; Pietrzak et al., 2009; Burnam et al., 2008; Office of the Surgeon General U.S. Army Medical Command, 2011).<sup>2</sup> Ouimette and colleagues (2011) examined a sample of Vietnam and Iraq/Afghanistan veterans who had been diagnosed with post-traumatic stress disorder (PTSD) by a Department of Veterans Affairs (VA) provider but who had not received any VA treatment in the past two years. When asked why they had not received treatment, veterans stated that stigma-related factors (e.g., fears about social repercussions of seeking treatment) were more salient than institutional or structural factors (e.g., VA staff skill, logistics). Vogt (2011) has suggested that there are three broad categories of barriers to VA care: individual characteristics, institutional factors, and stigma-related beliefs surrounding psychological/psychiatric care. Bolstering resilience by encouraging service members to seek behavioral health care before psychological problems worsen is all the more important, because service members who screen positive for psychological problems are likely to have stronger levels of stigma; in the Joint Mental Health Advisory Team study of service members in the Army and

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<sup>1</sup> The importance of perceived social support is also discussed in the companion report on the social domain (McGene, 2013).

<sup>2</sup> Although our discussion focuses only on service members, stigma is a potential barrier to psychological care for civilians as well (Corrigan, 2004).

Marine Corps (Office of the Surgeon General U.S. Army Medical Command, 2011), perceptions of stigma with seeking care, such as feeling embarrassed or worrying that it would harm one's career or be seen as weak, were reported twice as frequently among soldiers in theater who screened positive for mental health problems as among those who did not.

## Summary

A number of structural and individual-level factors have been linked to either facilitating the receipt of high-quality care or as presenting potential barriers to receiving such care. It is important to remember that these factors do not operate in isolation. Instead, clusters of factors (e.g., income, minority status, gender, distance to health care providers) work together to determine one's access to quality health care. Acting on factors that are more mutable, such as reducing transportation barriers, and introducing higher-level policies and programs, such as evidence-based stigma reduction programs, may be good interventions to addressing barriers to accessing quality medical care. After the review in this chapter of the four categories of medical fitness resilience factors, we turn our discussion next to those factors that have received the most attention in the intervention literature.

## 5. The Presence and Management of Chronic Conditions

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Some chronic health conditions can interfere with job performance, readiness, and quality of life. This chapter discusses the presence and management of chronic conditions as metrics of medical fitness and the scientific evidence on how the presence and management of specific conditions directly influence well-being or contribute to resilience and how the negative effects of stress influence physical and psychological well-being. Among the most common chronic health conditions for Americans under age 40 are diabetes, hyperlipidemia (e.g., high cholesterol), hypertension, cardiovascular conditions, and asthma (Stagnitti, 2010). In this chapter, we focus on overweight/obesity, diabetes, and asthma, given that they are a growing concern among Airmen, their families, and civilians who work for the Air Force (Bray et al., 2009; Mission: Readiness, 2010; Hoffman, 2008; Hatzfeld, LaVeist, and Gaston-Johansson, 2012). Although injuries and associated chronic pain can be thought of as a subset of chronic conditions, an extensive body of literature discusses the effect of injuries on resiliency and ability to cope with stress, especially among service members. We therefore cover injuries and chronic pain in a separate chapter.

Clinical diagnoses of chronic conditions are generally made by a diagnosing physician and accompanying laboratory results. The presence of these medical conditions can be assessed using medical records, self-reports, or administrative databases. Since administrative databases that record these diagnoses and laboratory results can be cumbersome to access and costly to clean and analyze, researchers often circumvent these hurdles by using surveys soliciting self-reported recall of a doctor's diagnosis within a certain time period (e.g., within the last year, or since the last assessment). For instance, the Air Force Web-Health Assessment) is used to gauge the presence of medical conditions that require attention during service members' annual physical health assessment by asking "During the past 5 years have you been told by a health care provider that you have any of the following health conditions or are you currently being treated for any of the following health conditions?"

There are no standardized measures to assess health conditions by self-reports, although there are some commonly collected types of self-report data (e.g., height and weight; frequency of alcohol, tobacco, and other use; family history of chronic conditions). Questions are tailored to assess the presence or absence of specific medical conditions. However, evaluation by a physician is considered the gold standard in assessing patient health (Wada et al., 2008; Shotorbani et al., 2006). Medical research continues to evaluate the validity of answers to self-reported diagnoses by comparing

answers to administrative databases or to biomarkers of disease risk and clinical consensus of disease presence. There is evidence that self-reports are generally accurate (Wada et al., 2008) and valid indicators of health status (Miilunpalo et al., 1997) and that for some conditions (e.g., hypertension), there can be a high degree of concordance between self-reports and physician reports, with the patients often being able to identify a contraindication better than the providers in cases of disagreement (e.g., when treatment may interfere with a pre-existing condition) (Shotorbani et al., 2006).

Self-rated *perceptions* of health are another frequently used measure of health status in surveys. Even a single item indicator of subjective well-being that asks “How would you rate your health in general/at the present time?” has been linked to depressive symptoms, health-related quality of life, risk of adverse clinical outcomes, and mortality among both healthy individuals and individuals who are at risk for poor health outcomes (e.g., those with high blood pressure or coronary artery disease) (Ried et al., 2006; Benjamins et al., 2004; Franks, Gold, and Fiscella, 2003; Idler, Russell, and Davis, 2000; Bosworth et al., 1999; Johnson and Wolinsky, 1993). A commonly used measure of general functional health and well-being is the Short-Form 36 questionnaire (SF-36) (Ware et al., 1993). The SF-36 is made up of eight of the most frequently measured concepts in health surveys:

- limitations in physical activities as a result of health problems
- limitations in social activities because of physical or emotional problems
- limitations in usual roles because of physical health problems
- pain
- general mental health
- limitations in usual roles because of emotional problems
- energy and fatigue
- general self-rated health (Ware and Sherbourne, 1992).

The effective management of medical conditions is often assessed via the Healthcare Effectiveness Data and Information Set (HEDIS) measures. These measures address a range of health conditions and health issues, including use of asthma medication, control of high blood pressure, diabetes care, breast cancer screening, antidepressant medication management, and others. HEDIS is a widely used set of standardized inpatient and ambulatory performance measures in the health care industry (Bolmey, 2002; Appleby, 1995). All new measures, tests, and results related to the covered health issues are compared to HEDIS measures. HEDIS is used by more than 90 percent of the nation’s health plans and many leading employers and regulators to assess quality of care and services (National Committee for Quality Assurance, 2011). HEDIS also specifies how organizations should collect, audit, and report performance information and captures such other important constructs as customer satisfaction. In addition to the HEDIS patient

experience measures, the Agency for Healthcare Research and Quality's Consumer Assessment of Healthcare Providers and Systems program develops various surveys to assess patient experiences with health care and is often considered the gold standard measure of patient experiences (NCQA, 2011).

The presence of chronic conditions has been linked to depression and anxiety disorders, tobacco use, alcohol and other substance use disorders, and suicide ideation/attempts. Druss and Pincus (2000) report that, controlling for demographic factors and other mental health factors, the presence of a general medical condition was associated with a 1.3 times increase in the likelihood of suicidal ideation. Specifically, asthma and bronchitis were associated with a two-thirds increase in the odds of ever reporting suicidal ideation, and cancer and asthma were each associated with a four-fold increase in the likelihood of an actual suicide attempt. Other research reports similar findings, concluding that the presence of physical chronic conditions (e.g., high blood pressure, heart attack/stroke, arthritis, chronic pain or headaches, respiratory conditions, epilepsy, cancer) is a risk factor for suicidal behavior, even in the absence of other mental health conditions (Scott et al., 2010). Both chronic physical (e.g., diabetes, epilepsy) and mental (e.g., anxiety) conditions have also been linked to self-harm, suicide ideation, and suicide attempts in children (Barnes, Eisenberg, and Resnick, 2010; Greydanus et al., 2010).

## Obesity

The military has generally set a body mass index (BMI) of  $< 25 \text{ kg/m}^2$  as an acceptable weight standard. Nevertheless, being overweight (BMI between 25 and 29.9) or obese (BMI  $\geq 30$ ) continues to be a concern for the military, as only one in four young adults ages 17–24 is eligible for military service, and being overweight or obese is the leading medical reason why applicants fail to qualify for service (Mission: Readiness, 2010). Rates of overweight and obesity increased drastically from 1995-2005 in the military, similar to patterns seen in U.S. civilians (Bray et al., 2009).

In U.S. civilian adults, approximately 34 percent are obese (Flegal et al., 2010), and rates of obesity and overweight (Hoffman, 2008) in Airmen have been cited at approximately 12 percent and 55 percent, respectively. When the percentage of overweight (BMI  $\geq 25$ ) is included, that number rises to 68 (Flegal et al., 2010). Obesity in children between the ages of two and 19 is also high, with 17 percent obese (Ogden and Carroll, 2010). Obesity is associated with significant health risks, including high blood pressure, high cholesterol, type 2 diabetes, coronary heart disease, congestive heart failure, stroke, sleep apnea, gallstones, osteoarthritis, some types of cancer and cancer mortality, pregnancy complications, and premature mortality (Calle et al., 2003; Poirier

and Eckel, 2002; Willett, Manson, and Stempfer, 1995). Higher BMI has also been linked with work absenteeism and workplace injuries (Bungum et al., 2003). Moderate to extreme obesity (BMI > 35) is associated with more health-related limitations in the workplace and lower work productivity than for mildly obese workers (BMI between 30 and 34.9) (Gates et al., 2008).

Obesity has also been linked to mental health problems, although the direction of causality (i.e., whether obesity leads to mental health problems or vice versa) has been difficult to establish (Onyike et al., 2003; Goodman and Whitaker, 2002). In a cross-sectional national sample (i.e., measured at only one point in time) of whites and blacks in the general U.S. population, relatively increased BMI was associated with an increased probability of past-year major depression—a condition marked by long-lasting depression or marked loss of interest in nearly all activities; obesity was also linked with suicidal ideation among both men and women but with suicide attempts among only men (Carpenter et al., 2000). Another nationally representative study found cross-sectional associations between obesity and past-month depression but only among women (Onyike et al., 2003).

A review of longitudinal studies, which are more informative than cross-sectional studies because they follow individuals over time, showed bidirectional associations between depression and obesity, such that being either obese or overweight was associated with the subsequent onset of major depressive disorder (Luppino et al., 2010). The association between being overweight and later depression was significant only among older adults (defined as those between the ages of 20 and 59 and those over age 59) but not among younger adults (under age 20) (Luppino et al., 2010).

Obesity is associated with the development of depressive symptoms, self-stigma, reduced quality of life, and severe isolation (Puhl et al., 2001, 2003). In addition, research has shown that individuals who are unable to maintain weight loss are more likely to have a narrow range of coping skills (Drapkin, Wing, and Shiffman, 1995). For example, when obese individuals are exposed to stress or negative emotions, they tend to employ avoidant or impulsive styles of coping, such as escape/avoidance, eating to regulate mood or distract, smoking, taking drugs, taking tranquilizers, sleeping more, and wishing problems would resolve themselves (Kayman, Bruwold, and Stern, 1990; Byrne, Cooper, and Fairburn, 2003), and may eat in response to emotions (Byrne, Cooper, and Fairburn, 2003; Ganley et al., 1989)—all behaviors that are detrimental to medical fitness. In contrast, individuals who successfully maintain their weight loss show better coping skills by setting realistic expectations about their goals, accept achievements of smaller magnitudes as successes, engage in health-promoting behaviors on a long-term basis (i.e., longer than one year), and subscribe to active and flexible methods of adjustment over forms of rigid behavioral control (Byrne, Cooper, and Fairburn, 2003; Westenhoefer,

2001; Ferguson et al., 1992). Thus, prevention of obesity and treatment of existing obesity are of utmost importance of maintaining resilience and medical fitness.

Treatment for obesity using drugs or dietary changes, physical activity, and counseling interventions may ameliorate some of these negative physical and mental health outcomes. In addition, a large review that assessed the clinical effectiveness of bariatric surgery found that for moderately to severely obese individuals, weight loss surgery (bariatric surgery) was a more effective intervention for weight loss than nonsurgical options in terms of maintaining weight loss (Picot et al., 2009). However, evidence was mixed on the effects of bariatric surgery on quality of life and development of or remission of such associated problems as metabolic syndrome or type 2 diabetes.

Although many studies of body fat have focused on BMI, there are several other indicators of body fat including waist-hip ratio, skin-fold thickness, and waist circumference. Waist circumference has been used as a measure of abdominal fat in research settings and has shown stronger associations with cardiovascular disease risk factors than BMI (Janssen, Katzmarzyk, and Ross, 2004; Foucan et al., 2002). Skin-fold thickness is also used as a measure of body fat, but studies comparing its predictive ability to other measures of body fat show inconsistent associations (Birmingham et al., 1993; Imeson, Haines, and Meade, 1989; Larsson et al., 1984). A large, cross-sectional, nationally representative study of U.S. adults older than age 20 found that waist circumference was a better predictor than BMI of cardiovascular disease risk factors including hypertension (high blood pressure), diabetes, and low high-density cholesterol (Menke et al., 2007). Another longitudinal nationally representative study of U.S. adults over age 30 found that waist-to-hip ratio and waist-to-thigh ratio were strongly associated with mortality risk, above and beyond the predictive value of BMI and waist circumferences among middle-aged adults (Reis et al., 2009). However among older adults, BMI and waist circumference were more strongly predictive of mortality risk (Reis et al., 2009).

## Diabetes

According to the CDC (2011b), approximately 26 million people over age 20 have some form of diabetes (e.g., type 1, type 2, or gestational). This means that roughly 4 percent of the population between ages 20 and 44 and 14 percent between ages 45 and 64 are diabetic (CDC, 2011b). In 2010, just under two million new cases of diabetes were reported, with the majority (just over one million) occurring among individuals between ages 45 and 64 (CDC, 2011b). Among Air Force active duty members age 21 or older, diabetes is one of the most common chronic conditions (0.3 percent) (Hatzfeld, LaVeist, and Gaston-Johansson, 2012).

Sixteen percent of all individuals with diabetes are not currently being treated (CDC, 2011b). The CDC (2011b) estimates that diabetes costs exceeded \$170 billion in 2007. This number refers to both direct costs (e.g., treatment) and indirect costs (e.g., disability, work loss, premature mortality).

There are two main types of diabetes: types 1 and 2. Type 1 diabetes, formerly called juvenile diabetes or insulin-dependent diabetes, is usually first diagnosed in children, teenagers, or young adults. With this form of diabetes, the beta cells of the pancreas no longer make insulin because the body's immune system has attacked and destroyed them. Type 2 diabetes, formerly called adult-onset diabetes or noninsulin-dependent diabetes, is the most common form of diabetes. People can develop type 2 diabetes at any age, even during childhood. This form of diabetes usually begins with insulin resistance, a condition in which fat, muscle, and liver cells do not use insulin properly. At first, the pancreas keeps up with the added demand by producing more insulin. In time, however, it loses the ability to secrete enough insulin in response to meals. Being overweight and inactive increases the chances of developing type 2 diabetes.

Treatments for both type 1 and type 2 diabetes include medication (with either insulin or oral medications), dietary changes, physical activity, and controlling blood pressure and cholesterol. For decades, the diagnosis of diabetes was based on plasma glucose criteria, either the fasting plasma glucose or the two-hour value in the oral glucose tolerance test. WHO and the American Diabetes Association currently recommend diagnosing diabetes by measuring glycated hemoglobin A1c (HbA1c) and using HbA1c levels of 48 mmol/mol (6.5 percent or greater) as the cut point for diagnosing diabetes. However, a value of less than 6.5 percent does not exclude diabetes diagnosed using fasting glucose tests (WHO, 2011). The fasting glucose criteria for the diagnosis of diabetes remain valid as well (American Diabetes Association, 2012) (fasting plasma glucose  $\geq 126$  mg/dL or 2-h plasma glucose  $\geq 200$ mg/dL during an oral glucose tolerance test. A diabetes care article discusses the pros and cons of using HbA1c to diagnose diabetes (American Diabetes Association, 2011).

The consequences of diabetes are far-reaching and extend beyond other health complications. A telephone interview of randomly sampled U.S. adults revealed that health-related lost productive time was 18 percent higher in diabetic adults who reported neuropathic symptoms, such as tingling hands or feet and numbness, and 5 percent higher in nonsymptomatic diabetics than in adults without diabetes. The study estimated that workers with diabetic neuropathic symptoms lost 1.4 hours of work per week and contributed to the loss of approximately \$3.65 billion each year as a result of diabetes-related loss of productivity (Stewart et al., 2007). Diabetes has been linked to absenteeism, work loss, and health-related work limitations among older adults ages 51–61 (Tunceli et al., 2005). Also, an extensive number of epidemiological studies have

examined the longitudinal linkage between diabetes and depression (see Golden et al., 2008). A meta-analysis indicated that the evidence for a relationship between type 2 diabetes and subsequent risk for depression is modest, although this relationship is understudied, and that the association between depression and subsequent risk for type 2 diabetes is strong and robust (Mezuk et al., 2008). One review also suggests that adherence to diabetes treatments leads to better glycemic control and decreased use of health care resources; however, there was little evidence on whether adherence was related to better quality of life (Asche, LaFleur, and Conner, 2011).

## Asthma

Asthma, an inflammatory disease of the airways that results in difficulty breathing, is another common respiratory disorder. According to the National Health Interview Survey, approximately 8 percent of the U.S. population currently has asthma (7.7 percent of adults and 8.2 percent of children) (Moorman et al., 2011). Almost 1 percent of active duty Air Force members age 21 or older has asthma (Hatzfeld, LaVeist, and Gaston-Johansson, 2012). Research indicates that asthma can be affected by anxiety, stress, sadness, environmental irritants or allergens, exercise, and infection. Similar to chronic obstructive pulmonary disease (COPD), asthma is often correlated with anxiety and depressive disorders (Lehrer et al., 2002). A study of community-dwelling adults in Baltimore found a longitudinal association between asthma and higher odds of suicide ideation and attempt, even after adjustment for major depression and treatment for asthma (Goodwin and Eaton, 2005). Factors that tend to worsen asthmatic effects are nonadherence to prescribed medical regimens, exposure to asthma triggers, and inaccurate perceptions of asthma symptoms (Lehrer et al., 2002). Asthma is generally managed using inhaled corticosteroids combined with drugs that reduce bronchoconstriction (Rottier and Duiverman, 2009). Most patients respond well to asthma therapy. Uncontrolled asthma can lead to lower quality of life, future lung damage, and even mortality (Global Initiative for Asthma, 2009; van Gent et al., 2007).

The negative effects on well-being also apply to children with asthma. In a review article, Everhart and Fiese (2009) identified a relationship between asthma severity and health-related quality of life among children. Children whose asthmatic symptoms were not well managed experience an impaired quality of life. Thus, the author concluded that asthma severity should be integrated into objective measurements of quality of life (Everhart and Fiese, 2009).

## Summary

This chapter has focused on the presence and management of chronic medical conditions that may limit an individual's ability to be resilient in the face of stress. In particular, measurement of the presence of obesity, diabetes, and asthma may be important for the Air Force, as they are associated with additional medical conditions as well as psychosocial complications. Both primary and secondary preventive care can keep symptoms of these diseases at bay. However, as we review in the next chapter, some factors may hinder access to appropriate quality health care.

## 6. The Presence and Management of Injuries

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Injuries are another possible aggravating factor should Airmen, civilians, or families be exposed to stress or strain. The presence and management of injuries can be thought of as metrics of medical fitness in that they affect well-being and may exacerbate or buffer the effects that exposure to stress has on well-being. Injuries are defined as the physical damage resulting from exposure of the human body to sudden intolerable levels of energy (Sommers, 2006).<sup>1</sup> They are most commonly classified by intent (intentional or unintentional), mechanism of injury (penetrating or blunt), and the temporal pattern (acute or chronic) of the injury (Sommers, 2006).

The detection and management of injuries are key steps toward determining the appropriate choice of health care options. Strategies to detect injuries have evolved over time and include direct visualization, topical dye application, and colposcopy<sup>2</sup> (Baker and Sommers, 2008). Direct visualization is the current standard assessment technique used to identify injuries to such body areas as the head, neck, face, trunk, and extremities (Baker and Sommers, 2008). The addition of topical dyes to the skin (e.g., toluidine blue) may be used to highlight abraded or lacerated skin. Colposcopy facilitates illumination, magnification, and documentation of injuries to internal and external areas (Baker and Sommers, 2008).

Trauma scoring scales can be used to score the severity and distribution of injuries (Chawda et al., 2004). Scales that measure the severity of injuries include the Injury Severity Score (ISS), the New Injury Severity Score (NISS), and the Trauma and Injury Severity Score (TRISS). Scales measuring injury distribution include the Glasgow Coma Scale (GCS), the Abbreviated Injury Scale (AIS), and the Organ Injury Scale (OIS) (Chawda et al., 2004). Most severity scales use a combination of the injury severity and distribution scales to come up with the final score(s). The ISS is used to numerically describe the severity of one or multiple injuries. Individual ISS scores are determined by rating each injury in six body areas (head, face, chest, abdomen, extremities [including pelvis], and external) using the AIS and then summing up the squares of the highest AIS rating for each of the three most severely injured body areas (Baker and O'Neill, 1976). The ISS can range from 0 to 75. The AIS ranges from one to six with one being minor

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<sup>1</sup> Workplace injuries are also discussed in the companion report on the environment (Shih et al., forthcoming).

<sup>2</sup> Colposcopy is used primarily in cases of sexual trauma.

injury and six being an unsurvivable injury. If an injury is assigned an AIS score of six (unsurvivable), the ISS score is automatically assigned a value of 75. More recently, the ISS was modified slightly to create the NISS in which the scores are based on the three most severe injuries regardless of body region. The TRISS determines the probability of survival of a patient using the ISS scores and scores from the Revised Trauma Scores, which is a common measure of physiologic trauma consisting of the GCS, systolic blood pressure, and respiratory rate.

Other injury distribution measuring scales include the OIS (Moore et al., 1995) used by the American Association for Surgery of Trauma. The scale ranges from one to six for each organ, with one being the least severe and five being the most severe type of organ injury from which an individual may survive. A score of six is by definition considered unsurvivable. The organs considered include thoracic vascular, lung, heart, chest wall, diaphragm, spleen, liver, abdominal vascular, kidney, ureter, bladder, and urethra. The Anatomic Profile (AP) was developed to address the limitations of the AIS. Unlike the ISS, the AP takes into account all serious injuries to a body region and also weighs injuries to the head and the torso more heavily than those incurred on other body parts. The AP summarizes all injuries with an AIS score greater than three into four categories. Category A consists of injuries to the head and spinal cord, category B includes injuries to the thorax and anterior neck, category C includes all remaining serious injuries, and category D includes all nonserious injuries. Each component of the AP is calculated as the square root of the sum of the squares of the AIS scores of all serious injuries within each body part (Chawda et al., 2004).

## Traumatic Injury

Injuries can arise from many sources, including exercise, accidents, combat, or working conditions. Major traumatic injuries are defined as injuries scoring greater than 16 on the ISS scale (Halcomb et al., 2005). A review study that examined outcomes following traumatic injury found key themes, including long-term loss of productivity in both society and the workplace, a high incidence of psychological symptoms, a link between poor recovery and increased drug and alcohol consumption, and a link between social support systems and better recovery (Halcomb et al., 2005). Several studies have shown that traumatic injury is subsequently associated with depression, PTSD, lower rates of returning to work, lower general health, lower quality of life, and lower overall satisfaction with recovery (Michaels et al., 2000; Shih et al., 2010; Zatzick et al., 2008).

Injury management involves identifying and treating an injury. Once an injury is detected, the injured person should be referred to a qualified professional for definitive diagnosis and further management.

Multiple-combat injuries (or polytrauma) are also of concern for service members sustaining an injury. A study of 49 TBI patients with and without polytrauma found that although health-related quality of life was similar in both types of patients and improved over time, physical functioning was significantly more impaired 12 months post-trauma in patients with polytrauma (Lippert-Gruner et al., 2007). The Task Force on Returning Global War on Terror Heroes has created a polytrauma identifier to allow better identification of Operation Enduring Freedom/Operation Iraqi Freedom (OEF/OIF) service members and veterans with polytraumatic injuries (Task Force on Returning Global War on Terror Heroes, 2007). Case management is a key component to ensuring lifelong coordination of polytrauma patient services (Sigford, 2007; Tanielian and Jaycox, 2008, p. 312). The VA assigns every patient a care manager, who maintains scheduled contacts with veterans and their families to coordinate services and referrals for additional services.

## Traumatic Brain Injury

According to the National Institute of Neurological Disorders and Stroke (NINDS, 2011), TBI is a major public health problem, especially among males between ages 15 and 24, among the elderly, and in children age five or younger. It is estimated that each year, 1.4 million individuals experience TBIs; approximately one million people are treated each year for brain injuries; 230,000 people who were hospitalized for TBI survive their injuries; and approximately 50,000 die from head injuries (NINDS, 2011). As a large body of research has focused on TBI and its consequences for health and well-being, we only briefly review some of that research here.

DoD defines TBI a “traumatically induced structural injury and/or a physiological disruption of brain function as a result of an external force” (Defense Centers of Excellence for Psychological Health and Traumatic Brain Injury [DCOE], 2011). This definition is consistent with definitions used by other major U.S. agencies, such as NINDS. DCOE (2011) defines four different grades of TBI:

- Mild TBI/concussion is described as a confused or disoriented state lasting 24 hour or less, loss of consciousness for up to 30 minutes, or memory loss lasting less than 24 hours.
- Moderate TBI is indicated by a confused or disoriented state lasting more than 24 hours, loss of consciousness for more than 30 minutes but less than 24 hours, or memory loss lasting greater than 24 hours but less than seven days.
- Severe TBI is defined as a confused/disoriented state, or loss of consciousness lasting more than 24 hours, and memory loss for over seven days.
- Penetrating TBI or open head injury occurs when the outer layer of the brain is penetrated by a foreign object.

TBI symptoms can be classified into three categories: physical, cognitive, and behavioral/emotional (DCOE, 2011). Physical symptoms include headaches, dizziness, blurred vision, sleep disturbances, numbness, and tingling. Cognitive symptoms include difficulties with attention, concentration, memory, processing speed, judgment, and executive control. Behavioral and emotional symptoms include depression, anxiety, irritability, impulsivity, and aggression.

Screening for TBI is important for early treatment and ideally occurs as soon after an injury as possible. A standardized TBI evaluation includes the Military Acute Concussion Evaluation tool to identify high-risk service members (Defense and Veterans Brain Injury Center, 2007; French, McCrea, and Baggett, 2008). Within the civilian population, TBI is generally assessed using a combination of consciousness and injury rating scales, such as the GCS (Jones, 1979) and the Disability Rating Scale (Rappaport et al., 1982).

TBI has been linked to several short- and long-term consequences, including depression and anxiety (Whelan-Goodinson, 2009), low return to productivity (Wood and Rutterford, 2006), loss of independence (Dikmen et al., 1995), reductions in social networks (Finset et al., 1995), personality and behavioral changes (Ommaya et al., 1996), chronic pain (Nampiarampil, 2008), suicide ideation and completion (Simpson and Tate, 2002; Teasdale and Engberg, 2001), and use of avoidant coping (Krpan, Stuss, and Anderson, 2011). Avoidant coping in particular has been shown to be strongly predictive of several negative outcomes including low return to productivity and work potential (Dawson et al., 2007; Matthews and Campbell, 2009).<sup>3</sup> Although some studies report no differences in coping in individuals with and without TBI, one experimental study of simulated stress found that, despite similar levels of subjective and objective stress measure, individuals with TBI engaged in more avoidant coping (Krpan, Stuss, and Anderson, 2011).

Numerous epidemiological studies have linked TBI with depression or such anxiety-related disorders as PTSD (Fear et al., 2008; Hoge et al., 2008; Schneiderman, Braver, and Kang, 2008; Vasterling et al., 2006; Moldover, Goldberg, and Prout, 2004). In a review of studies that examined TBI and long-term psychiatric health problems at least six months post-TBI, there was limited evidence for the development of PTSD in military populations with TBI and inadequate evidence for a relationship among civilian populations (Hesdorffer, Rauch, and Tamminga, 2009). The directionality of the relationship between TBI and substance use, PTSD, and depression is often unclear because of overlapping symptoms and difficulty with recall after loss of consciousness (Bjork and Grant, 2009; Karney et al., 2008; Babin, 2003; Kim et al., 2007).

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<sup>3</sup> Coping is also discussed in the companion report on the psychological domain (Robson, forthcoming).

TBI has been shown to increase the risk for suicide, as demonstrated in numerous studies. For instance, 23 percent of outpatients with TBI report suicide ideation (Simpson and Tate, 2005), and community-based individuals with TBI had at least a three times higher incidence rate of suicide mortality than the general population (Teasdale and Engberg, 2001). One scale, in particular, has been examined as a predictor of suicidal behavior in veterans with TBI. The Suicide Potential Index in the Personality Assessment Inventory's (Morey, 1991, 2007) is a 20-item measure of such risk factors as severe anxiety, poor impulse control, hopelessness, and worthlessness. Breshears and colleagues (2010) found that a cutpoint cutoff of 0.15 most optimally predicted suicidal behavior.

In a review of articles that explored the prevalence of chronic pain as a consequence of TBI, prevalence was greater in patients with mild TBI (75.3 percent) than in those with moderate or severe TBI (32.1 percent) among civilian populations (Nampiarampil, 2008). Three studies that assessed TBI among 917 veterans cited a pain prevalence of 43.1 percent. Although psychological disorders, such as PTSD and depression, may have explained some of the chronic pain reported among individuals with TBI, chronic pain does appear to manifest independently of PTSD and depression.

TBI among service members also increases the risk of discharge from the military, especially among those with co-occurring substance use problems (Ommaya et al., 1996). The risk of discharge is higher for those with moderate TBI than for those with mild TBI, although those with severe TBI did not have higher rates of substance use disorder-related discharge (Ommaya et al., 1996). Comorbid TBI and substance use are also associated with lower likelihood of returning to work, decreased life satisfaction, and greater risk of continued abuse postinjury (Taylor et al., 2003). In a study of soldiers returning from Iraq, those with mild TBI missed more workdays than those without TBI (Hoge et al., 2008). Although no studies to date have linked TBI with lower work productivity, some small, experimental studies suggest that patients with moderate to severe TBI are less attentive to common work tasks (Whyte et al., 2000; Tanielian et al., 2008).

There are major demographic differences in the risk of suicide associated with TBI. Although suicide rates differ by gender in the civilian population, TBI appears to have a greater effect on females' risk of suicide (Oquendo et al., 2003; Teasdale and Engberg, 2001; Henriksson et al., 1993), although not all studies agree (Simpson and Tate, 2002). In addition, different types of TBI, as well as length of hospital stay following TBI, are associated with differential risk of suicide, such that those with cerebral contusions, traumatic intracranial hemorrhage, and longer length of hospital stay have higher rates of suicide than those with concussions, cranial fractures, or shorter hospital stays (Teasdale and Engberg, 2001). Individuals with TBI who have co-occurring substance use disorders also have higher risk of suicide (Simpson and Tate, 2005).

The effect of TBI on veterans is also important for the well-being of spouses, partners, and other family members. Wives of veterans with TBI reported higher levels of distress and psychiatric symptoms than did wives of healthy veterans (Ben Arzi, Solomon, and Dekel, 2000). TBI has also been linked to intimate-partner violence in civilian populations, presumably as a result of the loss of impulse control and aggressive behavior that often co-occur with neurological damage associated with TBI (Dyer et al., 2006; Kim, 2002; Marsh and Martinovich, 2006), although this research suffers from sampling issues, since most study participants were recruited from populations receiving treatment for abusing their partners (Karney et al., 2008). Studies conducted on small samples of parents with TBI also suggest parenting deficits (Uysal et al., 1998; Pessar et al., 1993).

The goal of rehabilitation, after diagnosis of TBI, is to allow the patient to function both at home and in society. Rehabilitation generally takes a multidisciplinary approach and includes medical, physical, psychological, and social aspects (Kahn, Baguley, and Cameron, 2003; for a review of the DoD system of care for veterans suffering from TBI, see Burnam et al., 2008). Because family members are often key to successful rehabilitation, it is important that they have access to relevant information about TBI, its symptoms, and the techniques most helpful to TBI patients (Perlick et al., 2011; Collins and Kennedy, 2008). It is also important to note that family members of TBI patients may need their own support system, independent of the patient (Collins and Kennedy, 2008; Kreutzer et al., 2009).

## Chronic Pain

Chronic pain is one of the most prevalent and costly health care problems in the United States. Motor vehicle accidents and work-related injuries are two of the most common causes of chronic pain (Jenewein et al., 2009). Individuals with chronic pain, compared to those without, report symptoms of PTSD, depression, anxiety, more disability and more days off work (Jenewein et al., 2009). In addition, in a survey of chronic and acute pain patients, chronic pain patients had a greater risk for suicidality (e.g., history of reporting that they wanted to die, recent frequent suicide ideation, having a suicide plan) than pain-free control community members (Fishbain et al., 2009). Wilsey and colleagues (2008) reported that patients with chronic back pain were at an increased risk of abusing opioids, suggesting that patients with chronic pain should also be screened for addiction disorders.

The majority (> 52 percent) of OEF/OIF service members report experiencing pain symptoms as they move between DoD and Veterans Health Administration (VHA) or retire into the VHA system for care (Office of Public Health and Environmental Hazards,

2010). VHA and DoD have clinical practice guidelines in place for the management of opioid therapy for chronic pain (Department of Veterans Affairs/Department of Defense, 2010). However, a report of the Pain Management Task Force notes that there is currently no coordination of care between DoD and VHA pain services and recognizes that better patient coordination may lead to decreased medication use (particularly opioids)(Office of the Army Surgeon General, 2010). The Defense and Veterans Pain Management Initiative sponsors the Joint Regional Anesthesia and Analgesia Tracking System, an electronic pain record that attempts to help standardize pain care by providing DoD and VHA clinicians with a detailed pain management history of the patient; it has the potential to evaluate treatment trends and outcome measures (Defense & Veterans Center for Integrative Pain Management, undated) (Office of the Army Surgeon General, 2010).

There are many scales to assess pain among those with cognitive challenges. Stolee et al. (2005) reviewed 39 instruments for older adults with cognitive impairment and reported that none of the scales met contemporary validity and reliability standards. More research is needed on the validity and reliability of measures of pain among service members with combat-related polytrauma, as these individuals have uniquely different challenges including TBI-related cognitive challenges, emotional distress, or overt psychiatric disorders (Clark et al., 2007).

A number of psychosocial indicators have been found to be useful in predicting failure to return to work after back injury and could also be extended to determine which patients will develop prolonged pain in other situations. These psychosocial factors include belief that back pain is harmful or potentially severely disabling, fear-avoidance behavior (e.g., avoiding activities in anticipation of pain), tendency to develop depressive mood and withdraw from social interaction, and an expectation that passive treatments provided by a health care specialist are better than active patient participation, such as engaging in physical therapy exercises at home (Goucke, 2003; Kendall, 1997). Preexisting psychological factors, such as depression, anxiety, and post-traumatic stress, can affect a person's perception of pain and result in poor adaptation after injury, which can influence other health outcomes and general functioning (Gonzales, Martelli, and Baker, 2000; Jenewein et al., 2009).

Several instruments that assess the psychological functioning of individuals with chronic pain are summarized by Gonzales and colleagues (2000). These instruments assess pain intensity, behavioral and functional limitations, pain behaviors, thoughts, attitudes and appraisals of pain, beliefs and attitudes about pain, mood and anxiety, and coping strategies. Instruments that measure how well an individual is able to cope with pain include the Coping Strategies Questionnaire (Rosenstiel and Keefe, 1983), which rates the frequency of employing different cognitive and behavioral coping strategies, and

the Vulnerability to Disability Rating Scale (Martelli, 1997), which assesses several constructs, including psychological coping liabilities and social vulnerability.

Medical management of chronic pain with drugs is not usually sufficient, as it does not necessarily address coping skills and other psychosocial components that may be involved. Treatments that are holistic or multidisciplinary in nature and address pain using drugs and physical exercises, as well as cognitive behavioral therapy that focuses on how the individual reacts to pain and disability management, are better than those that focus only on pain management through medication or psychological treatments alone (Lang et al., 2003; Gonzales, Martelli, and Baker, 2000). Supportive counseling, education, and reassurance, as well as consideration of other short-term psychological therapy (e.g., problem solving) from physicians or other skilled health workers, should be instituted in combination, if appropriate, with medicinal treatment.

## Summary

This chapter has reviewed the negative health and well-being consequences of injuries that can seriously compromise overall medical fitness. Although certain types of injuries, such as TBI, are perhaps more common among Airmen, the negative health consequences of experiencing physical trauma can have repercussions for family well-being as well. All of these negative consequences can reduce overall resilience to ongoing or novel stressors. Several robust psychosocial and psychological measures exist that can help identify individuals at risk for prolonged pain associated with injury and poor coping behaviors.

## 7. Interventions to Promote Medical Fitness

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Many programs, policies, and interventions may be able to bolster medical fitness through disease prevention, detection, and management. These programs can be implemented at individual, family, community, and clinical levels. Programs are often tailored to each medical condition, such as early screening for diabetes and management of TBI, and interventions that improve treatment adherence for certain chronic conditions, such as diabetes and asthma. Some interventions seek to reduce stigma to seek health care, to remove physical and social barriers to care, or to bolster social support to improve health care access and care-seeking. The realm of these programs, policies, and interventions is vast and beyond the scope of this report to review and evaluate. Thus, we focus on interventions that address prevention of medical conditions.

Although research on the medical effect of routine health care visits is mixed, preventive care is one of the most obvious ways to prevent negative health outcomes and promote medical fitness (French, 2009; Maciosek et al., 2009). Prevention of medical conditions can reduce the social and economic burden associated with treatment, lost productivity, health care, and family and societal effects. Prevention can also improve the length and quality of individuals' lives (National Prevention Council, 2011).

Common preventive care includes not only routine visits to a physician but screenings for cancer and other diseases, immunizations, promotion of positive health behaviors (e.g., exercise, healthy diet), and cessation of negative health behaviors (e.g., smoking, physical inactivity).<sup>1</sup> Preventive care can also include public health and education campaigns that target general well-being as well as specific conditions.

Many preventive care interventions target individuals themselves and involve sending reminders about general preventive care (e.g., positive and negative health behaviors) as well as preventive care specific to conditions (e.g., diabetes, heart disease, obesity). The effectiveness of preventive interventions differs across the type of intervention, the target population, the target disease or condition, and many other variables. Thus, a complete review of all preventive care interventions is outside the scope of this report. Therefore, we discuss modification of health behaviors as a key theme that cuts across all programs and interventions. We also discuss the use of technology to disseminate intervention material. We then review the literature on health and wellness centers (HAWCs), as they represent an example of a centralized location where employers can provide preventive

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<sup>1</sup> Often, preventive interventions aimed at health behaviors are called health behavior change interventions.

care services and interventions (e.g., health education and coaching, health risk assessments, fitness centers) to workers and their families.

## Health Behaviors

Many preventive health interventions focus on health behaviors, either promoting positive ones or inhibiting negative ones. Although we address many specific health behaviors in other reports in this series (e.g., physical activity, healthy eating, drug and alcohol use), it is still useful to review some of the behaviors that have successfully been targeted by behavior change interventions. According to the Council of State Government's 2006 report, "Using Science to Prevent Chronic Diseases," the key ways to reduce such chronic health conditions as cancer, diabetes, obesity, and cardiovascular disease are to reduce tobacco use, increase physical activity, and improve nutrition. Not surprisingly, tobacco use, physical activity, and nutrition all have a large intervention literature associated with them.

### *Tobacco Use*

Prevention of tobacco use may be one way to reduce such medical conditions as asthma, COPD, hypertension, and many types of cancers (U.S. Department of Health and Human Services, 2012). Tobacco use prevention interventions can take two forms: One is aimed at preventing smoking among current nonsmokers, and the second targets smoking cessation among current smokers. Tobacco control interventions typically target individuals who may have not yet started to smoke or use other forms of tobacco. Much of this work is based in schools and is especially designed for children or adolescents. For example, in a review of the literature, Dobbins et al. (2008) found that school-based tobacco use prevention programs are effective at reducing smoking prevalence, smoking imitation, and smoking intentions—at least in the short term. Valery and colleagues (2008) conducted a systematic review of smoking cessation programs among adults who have already started smoking, and report that a number of different types of programs are effective, including group behavior therapy, intensive physician advice, telephone counseling, nursing interventions, tailored self-help interventions, price-increase legislation, and clean indoor air laws.

As we discuss below, the method of delivery of health behavior intervention programs can play a role in their effectiveness. In an update of their 2004 review, Bock and colleagues (2008) found an increase in the use of web-based tobacco interventions. Further, they also noted a 17 percent increase in programs that had at least one interactive feature. Although this finding suggests that interactive features are important for successful smoking intervention programs, especially those that use an impersonal

format, such as the Internet, more research is needed to understand whether and how interactive features can produce and sustain population-based health behavior change (see also Villanti et al., 2010).<sup>2</sup>

### *Physical Activity*

Given the high prevalence of overweight, obesity, diabetes, and cardiovascular disease in the United States, and associated negative health consequences, it is not surprising that a large number of studies have assessed the effectiveness of behavior change interventions aimed at increasing physical activity among both adults and children. A recent summary of reviews of school-based physical activity interventions for children and adolescents found that, depending on the review study, between 47 and 65 percent of randomized control trials were deemed effective (Kriemler et al., 2011). Multicomponent studies, including those with family-based components, were most effective. Michie and colleagues (2009) used meta-analytic techniques to identify which specific aspects of adult healthy eating and physical activity interventions are linked to effectiveness among adults. Programs that used self-monitoring techniques and at least one other self-regulatory technique derived from control theory (i.e., prompt intention formation, prompt specific goal-setting, provision of feedback on performance, and prompt review of behavioral goals) were more likely to be effective (Carver and Scheier, 1981, 1982).<sup>3</sup>

An additional review study investigated the long-term effectiveness of physical activity interventions targeted at adults (Müller-Riemenschneider et al., 2008). The authors found that compared to no-intervention and minimal-intervention control groups, intervention groups experienced roughly an 11 percent increase in physical activity. They conclude that there is evidence of long-term effectiveness of physical activity interventions; however, more tailored exercise programs seem most promising. They also noted that “boosters,” such as phone calls, direct mailings, and use of the Internet, can increase the effect of physical activity programs.

As we discuss below, workplace-based interventions are an important means through which behavior change and other preventive care interventions can take place. One recent review of worksite overweight and obesity interventions found that these programs can achieve modest improvements in employee weight (i.e., an average of 2.8 pounds, 0.5

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<sup>2</sup> Interventions for alcohol and other substance use disorders are also discussed in the companion report on the behavioral domain (Robson and Salcedo, forthcoming).

<sup>3</sup> Self-regulation is also discussed in the companion report on the psychological domain (Robson, forthcoming).

BMI ) in the 6- to 12-month follow-up period following the intervention (Anderson et al., 2009). The majority of studies in the review used a combined informational-behavioral approach to diet and physical activity, but fewer focused on the work environment itself (e.g., food available in cafeterias, exercise facilities).

### *Diet and Nutrition*

According to a study by Dalziel and Segal (2007), nutritional interventions represent a cost-effective, efficient approach to reducing the prevalence and morbidity associated with such conditions as diabetes, obesity, and cardiovascular disease. However, as with other programs aimed at reducing overweight and obesity through behavior change, it is not clear which aspects of programs are responsible for any effects associated with their use. As a result, diet and nutrition interventions are generally weakly associated with actual behavior change. For example, a recent review of European workplace interventions to promote healthy eating found limited to moderate evidence of positive effects (Maes et al., 2011). Complex interventions are far more difficult to assess precisely, because they have so many aspects that could affect behavior. An editorial by Yngve and colleagues (2011) notes that not all nutritional interventions need to be complex to be effective. In fact, the editorial is a preface to an entire journal issue featuring studies of relatively simple nutritional interventions, including placing fruit in an accessible spot in the workplace (Alinia et al., 2011) and providing more vegetable offerings (Bucher, van der Horst, and Siegrist, 2011). These relatively simple interventions led to improved nutritional intake by increasing the amount of fruits and vegetables that individuals consumed.

In addition to the selected programs mentioned above, the RAND Promising Practices Network provides a database of programs that aim to address health-related outcomes in children and their families, which include reducing substance abuse, improving access to and use of appropriate health services, and prevention of unintended injuries (Promising Practices Network, 2012).

### **Technology**

Because of technological advances and an increasing effort to improve access to preventive care, one aspect of preventive care interventions that has seen increased attention in the literature in recent years is the medium through which preventive care messages are sent. Receiving preventive care remotely may be efficacious for geographically separated Airmen or their families stationed at far-flung bases and because of the comparative limitations of having to travel to a HAWC or military treatment facility to receive care. In a review of health behavior change programs that

used mobile phone short-message service (SMS), or text messages, to convey messages on either preventive health care behavior (e.g., smoking cessation, physical activity) or clinical care (e.g., diabetes management, cardiac care), the authors found that 13 of 14 reviewed studies showed positive behavior change (Fjeldsoe, Marshall, and Miller, 2009). However, it is important to remember that these effects were generally short term, and little research has addressed the cumulative effectiveness of health-related text messages.

Other studies have examined the use of health behavior change interventions delivered via telephone (Eakin et al., 2007) or the Internet (Evers et al., 2003; Vandelanotte et al., 2007). Eakin and colleagues (2007) reviewed 26 studies that used the telephone as the primary method of intervention delivery. The authors found that positive behavioral outcomes (e.g., more exercise) were evident in 69 percent of physical activity studies, 835 of dietary behavior studies, and 75 percent of studies that addressed both behaviors. A higher frequency of calls was associated with successful outcomes. In a review of Internet programs designed to change health behaviors, Evers and colleagues (2003) determined that such programs showed promise, but many lack a clear theoretical basis, could be specifically tailored, or were evidence-based or had plans to evaluate the effectiveness of the intervention. In a more recent review, Webb and colleagues (2010) found that Internet-based behavior change interventions had a statistically significant but small effect on health-related behavior, and more extensive use of theory was associated with larger effects. Further, interventions that used additional means of communication with participants, especially text messages, were also more effective.

A recent multimedia initiative by the Air Force Medical Service seeks to improve patient health outcomes through promoting healthy living and health literacy through social media (e.g., Facebook, blogging, distribution of social media toolkits to health care personnel) (Schultz, 2012). Health literacy can be defined as “the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions” (U.S. Department of Health and Human Services 2000). This includes health promotion, disease prevention, and navigating the health care system. Health literacy may be especially critical to maintaining medical fitness in military personnel and their families, because they (1) include single, young, or first-time parents who may not have family and other social support nearby, (2) move frequently, making it difficult to establish robust patient-provider relationships, or (3) may rely on caretakers to coordinate care and to help in the recovery of combat-injured service members (Uniformed Services University of the Health Sciences, 2012). Although one study of 155 active duty military personnel found adequate health literacy skills compared to civilians, there were variations by race/ethnicity (Weld et al., 2009).

So, although Internet-based programs could be beneficial, to be most effective they must be well designed, with clear and specific goals in mind. Although not definitive, the collective body of evidence in the literature suggests that targeted intervention programs appear to be more successful than general ones (Noar, Benac, and Harris, 2007). And similar to interventions that use SMS or mobile text messages, it is not clear how sustainable the effects of Internet programs are. Nor is it clear which aspects of Internet-based intervention programs are most closely linked to effectiveness (Brouwer et al., 2011). However, Internet interventions have the potential to reach a large number of individuals and be more cost-effective than other more intense interventions requiring a more individualized approach.

## Worksite Health and Wellness Programs

One venue for enhancing medical fitness is worksite HWP. Perhaps even more important, these programs can be beneficial not only for medical fitness but also for physical, nutritional, psychological, social, and environmental fitness. Exactly what a HWP entails differs by organization but typically they contain at least one of the following:

- health risk assessments (e.g., blood pressure screenings)
- behavior modification programs (e.g., health coaching, smoking cessation, nutrition and diet, physical activity and exercise)
- educational programs (e.g., health fairs, online health resources)
- changes in the work environment (e.g., healthier food in cafeterias and vending machines) (Tu and Mayrell, 2010).

Punnett and colleagues (2009) note that HWPs should also include ergonomics programs.<sup>4</sup> By offering such diverse services, broad and diverse programs are able to reach the needs of a larger portion of employees. Yet the 2004 National Worksite Health Promotion Survey reported that less than 7 percent of responding workplaces offered comprehensive HWPs onsite (Linnan et al., 2008). Perhaps not surprisingly, larger firms (i.e., those with more than 750 employees) consistently offered more programs, policies, and services than did smaller firms, as did firms with dedicated health and wellness staff.

Goetzl and Ozminkowski (2008) note that HWPs support primary, secondary, and tertiary preventive care services. Primary care efforts are aimed at workers who are currently healthy, in an attempt to delay the onset of chronic conditions or other health

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<sup>4</sup> Workplace ergonomics are also discussed in the companion report on the environmental domain (Shih et al., forthcoming).

problems. Such efforts might include promoting physical exercise and activity, healthy eating, and stress management. Secondary care efforts are targeted at those who are at risk, because of either lifestyle factors or preexisting conditions (e.g., high cholesterol or blood pressure). Examples of secondary care efforts include screenings, weight management programs, smoking cessation programs, and financial programs to help purchase needed medication. Tertiary care is sometimes referred to as disease management, since it applies to individuals who already have a health problem (e.g., asthma, cardiovascular disease, depression). These efforts try to influence adherence to treatment.

Motivations for employers to offer HWPs differ but generally fall into three categories, including reducing direct medical costs, boosting worker productivity and indirectly reducing medical costs (e.g., through reduced disability claims), and enhancing corporate reputation as an “employer of choice” (Tu and Mayrell, 2010; see also Goetzel, 2005). Generally, employers see a direct link between employee health and employee performance, safety, and morale. The workplace is one area in which both employees and employers have the same goal, namely, profitability of the organization. Thus, workplace-based HWP would appear to be mutually beneficial (Goetzel and Ozminkowski, 2008).

From a review of the literature and assessment of data from interviews with wellness experts and industry leaders of companies where wellness programs are in place, Tu and Mayrell (2010) offer several key takeaways of successful workplace HWPs. First, one-size-fits-all programs that do not take into account the specific culture of the workplace are less likely to be effective. Second, successful HWPs have buy-in from leaders who clearly communicate the goals of the program and what constitutes success. Third, communication between program directors and employees must be continual to both keep people interested and keep information current. Fourth, financial incentives for participation are tied to success but can lead to dependence on financial rather than health rewards. And fifth, HWPs are not quick fixes, and determining return on investment (ROI), either financially or health-wise, can be difficult.

Goetzel and Ozminkowski (2008) add their own list of important HWP characteristics, and many overlap with those of Ty and Mayrell (2010). Notably, Goetzel and Ozminkowski note that use of some type of employee health risk assessment (HRA) is necessary to first establish what type of programs should be included in HWPs. HRAs provide a baseline status for employee health. Successful HWPs also

- have high participation rates
- provide employees with tailored health information
- allow employees to actively participate in their own care through self-management and self-care

- simultaneously address multiple risk factors and use a number of modalities (e.g., individual counseling, group classes, print material, internet material)
- make employees' access to programs easy and convenient
- involve family members and other social support
- use some financial incentive (typically with respect to participating in an HRA)
- foster a sense of a "health community" within the organization.

In terms of assessing the ROI of HWP, Baicker, Cutler, and Song (2010) review existing studies and find that for every dollar spent on wellness programs, corporate medical costs fall by \$3.27, and absenteeism costs (i.e., costs associated with loss of productivity resulting from health-related absence from work) fall by \$2.73. Although a number of other studies have shown health-related cost reductions associated with firm-specific HWPs (Ozminkowski et al., 1999, 2002; Bly, Jones, and Richardson, 1986; Fries et al., 2004), it is still not clear which specific aspects of programs are associated with ROI measured in this manner.

It is also important to note that HWPs have also been tied to actual employee health. A 2007 review by the Community Guide Task Force found strong evidence that HWPs were effective in reducing tobacco use, dietary fat consumption, high blood pressure, and serum cholesterol levels (Task Force Community Preventive Services, 2007). Unfortunately, there was insufficient evidence to assess the association between HWPs and dietary intake of fruits and vegetables, reducing overweight and obesity, and improving physical fitness.

## Summary

In this chapter, we have reviewed two key aspects of preventive care interventions: targeting health behaviors and the use of technology. We highlighted interventions aimed at three specific health behaviors: tobacco use, physical activity, and nutrition. In general, interventions targeted at these health behaviors have small to medium, statistically significant effects on behavior. However, the literature is less clear on which actual aspects of programs are associated with effectiveness. The content of preventive care interventions can be disseminated in a number of ways, but with the increased use and importance of electronic media in people's lives, the use of the Internet and SMS or text messages has also increased. Reviews of interventions that use electronic methods of distribution indicate that these methods have promise but that theoretically motivated, targeted, specific messages have the most effect. Unfortunately, the duration of that effect is unknown. Finally, we highlighted the potential of workplace HAWCs in providing preventive care services and improving medical fitness.

## 8. Conclusion

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The goal of this report was to review and highlight the relevant constructs and measures of medical fitness as well as initiatives designed to improve medical fitness. This fitness domain is not mutually exclusive from the other domains, as the measures reviewed herein are often related to metrics used to measure other fitness domains. Likewise, the interventions we reviewed also relate to interventions of relevance to the behavioral, psychological, and nutritional fitness domains. These findings provide the foundation against which the larger study on Total Force Fitness assessed current Air Force metrics, policies, and programs.<sup>1</sup>

We focused on four main constructs of medical fitness: preventive care, management of injuries, management of chronic conditions, and facilitators and barriers to quality health care. After reviewing the body of evidence, we recommend that the Air Force implement (and in some cases continue to enforce) the points listed below for Airmen, their families, and Air Force civilians:

- Ensure that immunizations and hearing, vision, and dental screenings are received. These are each associated with reduced risk of disease and disease burden, especially among those with chronic conditions (e.g., cardiovascular disease, obesity).
- To the extent possible, focus efforts on facilitating health care access and health care-seeking behaviors among vulnerable populations defined by SES, perceived stigma, gender, race/ethnicity, language, and geography. These are the most important individual-level factors that facilitate access to, or pose barriers to, health care. It is important to remember that these factors work in tandem.
- Provide treatment plans for injuries (e.g., TBI and related chronic pain) that focus on both the sufferers and their families. These plans have proven to be more effective in reducing the negative effects on resiliency than those that focus only on the injured service member.

In terms of interventions, we focused on exploring evidence for the efficacy of preventive services, or what are typically referred to as behavior change interventions. We recommend that the Air Force

- engage service members and their families in interventions that focus on changing many of the negative health behaviors addressed in other reports in this series,

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<sup>1</sup> Air Force-specific metrics, policies, and programs are also reviewed in the overarching report (Meadows and Miller, forthcoming).

- including physical exercise, nutrition and diet, and tobacco use, as they may be efficacious in preventing the onset and severity of chronic conditions and injuries
- employ multiple types of media in transmitting interventions, especially such electronic media as SMS or text messages and the Internet, which are gaining traction as an efficacious way to deliver preventive care and interventions.

Finally, we highlighted the use of workplace health and wellness programs to improve medical fitness through preventive services. Use of HWP's has increased in the past decade, as employer health care costs have skyrocketed. These programs show promise in terms of both reducing negative health behaviors and lowering employer health care-related costs. HWP's are quite varied in the services they offer; however, the most effective and successful programs share a few key characteristics. These include broad sets of components that address a number of health concerns (e.g., physical activity, diet and nutrition, screening, health education) yet also have the ability to provide tailored care and incentivized use of health risk assessments. The most effective programs also have buy-in from key leaders in the organization and use multiple mechanisms of conveying program-related information (e.g., print, electronic, group-level, individual).

Future studies should build on our work to summarize and evaluate the realm of existing interventions for traumatic injuries, chronic conditions, and barriers to care. Specifically, understanding which programs effectively screen and manage the treatment of traumatic injuries, address treatment adherence for chronic conditions, and reduce barriers to care for Airmen would contribute substantially to improving medical fitness.

Medical fitness is important not only because it is directly associated with the overall health and well-being of Airmen, their families, and civilian employees but also because it is a component of resilience. Individuals who are free of chronic disease, or who are successfully managing health conditions, and who make the necessary lifestyle changes to ensure health and well-being and prevent future health problems are more likely to efficaciously deal with stressful events and chronic strains when they occur. Health and wellness programs within the workplace may be one mechanism through which the Air Force can positively influence the medical fitness of both Airmen and their families.

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