Chapter 28

ROAD MAP FOR FUTURE AMPUTEE CARE RESEARCH

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INTRODUCTION

The global war on terror, like many previous conflicts, has brought about tremendous advances in amputee care, as well as revealing areas in need of further investigation. Although much can be learned from the care of individuals with major limb amputation among the civilian population, the military population is unique in many ways. Current injury patterns among wounded military service members involve complex amputations with often multiple complex comorbid injuries, such as burns, paralysis, traumatic brain injury (TBI), hearing and vision loss, mental health disorders such as posttraumatic stress disorder, and a multitude of soft tissue wounds and bony fractures. Combat wounds are often infected, requiring multiple debridements and extensive reconstruction. Fortunately, most members of the armed forces are young and highly active, often considered to be "tactical athletes." With the advances in acute combat casualty care, protective gear, and rehabilitation, in conjunction high premorbid levels of fitness, injured service members are often able to recover from wounds that were heretofore thought to be fatal, and, impressively, many return to very high levels of activities.

Many young service members have not yet established their long-term professional goals; for those who sustain a severe combat injury, this situation presents a significant challenge for recovery. Although some service members seek a professional military career, many individuals join the military as a means of exploring possibilities for future careers. Because much of the success for recovery and rehabilitation is accomplished through goal-driven behavior, it is helpful to have a clear idea of the goals and aspirations of each injured service member. Great success can be achieved by harnessing the military spirit of mission accomplishment, which may be translated to returning to active duty or regaining maximal functional recovery.

It is not uncommon, however, for young service members to equate "physical recovery" to "functional recovery," which are two independent goals. Physical recovery is important, but functional recovery involves much broader challenges, including behavioral health, socioeconomic and educational status, family and community support systems, vocational interests, and return to active participation in the community. It is the responsibility of the military and Department of Veterans Affairs (VA) medical and rehabilitation teams to assist all injured service members in establishing both short- and long-term goals with the overall objective of helping them reach their full potential.

The last time the US military healthcare system handled a large number of war injuries was in the 1970s, following combat actions in Vietnam. Although much of the knowledge gained and programmatic changes of this era were not thoroughly documented, significant advances in combat casualty care were achieved, particularly in medical and surgical resuscitation and medical evacuation techniques. During the intervening time, however, the focus of research within the Department of Defense (DoD) and VA shifted toward chronic care, secondary injury prevention, noncombat conditions, and health services research. All of these areas remain important; however, current conflicts in the global war on terror have brought about the need to refocus those research priorities. This chapter is an attempt to report on priorities that have been identified by experts in the field who have been providing ongoing combat casualty amputee care for the past 6 years. Although this chapter is not meant to be all encompassing, some of the broader policy issues are indirectly addressed, such as balancing the VA and DoD portfolios in bench science, clinical studies, engineering science, and heath services research. Furthermore, the contributors to this textbook believe strongly that injured service members (and their families) must play a pivotal role in research and developing research priorities. Therefore, their participation was solicited whenever possible in formulating the recommendations within this chapter.

PROGRAMMATIC GOALS AND OPPORTUNITIES

The military healthcare system has the obligation to provide expert, world-class combat healthcare delivery and rehabilitation. An active research program is essential to this mission. Unfortunately, most military clinical departments lack the research infrastructure typically available at major academic medical facilities. Despite this situation, many military healthcare providers and scientists are extremely productive researchers. Success is often achieved through collaboration within and among institutions, including military, VA, and civilian organizations. Conducting research within the military offers many unique opportunities, including its relative insulation from commercial and financial bias. Therefore, the military is well positioned to create and support programs seeking new knowledge and translating knowledge into practice to improve the lives of service members and their families.

Numerous mechanisms are available for supporting research to ultimately improve the medical and rehabilitative care of injured service members and to facilitate successful community reintegration, including return to duty. This chapter does not attempt to provide a comprehensive listing of all of the funding opportunities available, only noting that both private and public organizations provide research support. Each mechanism has its advantages. Private agencies tend to award smaller grants, but are able to assume more risk of failure and rely less on pilot data. Federal research funding agencies are typically more capable of making larger long-term investments concerning broader public health issues. The DoD is somewhat unique in that it can provide needed funding to address unique military problems that often benefit civilian populations. A key to making the greatest positive impact in research is to establish collaborative partnerships. Often a team approach works best; clinicians who have patient care responsibilities frequently struggle to maintain a productive research program. Conversely, basic or engineering scientists benefit from working closely with clinicians to gain a greater understanding of clinical and medical questions.

The challenges of current research include the many unknowns of treating injured or ill service members, in addition to limited research funding across the board, significant regulatory barriers and delays, restricted contact with study participants, and the severely limiting requirements of institutional review boards. One strong recommendation by this workgroup is for military treatment facilities and the Veterans Health Administration to establish cross-organizational centralized institutional review boards to allow submission to one board for multisite studies.

Both the VA and DoD need to invest greater resources over the long term in building research capacity. The area of greatest need is increasing the number of active and effective clinician-scientists, which is especially challenging to the military given frequent deployments, changes in duty assignments, and lack of a formal mechanism for protected long-term research time. Also, too few funds are available for education and research career development awards. Members of the Medical Corps, Nurse Corps, and Medical Service Corps have limited time and funding to participate in research training. The military and VA must grow a cadre of clinician and nonclinician scientists to address the problems facing this generation of veterans, as well as future generations. It is critical for students, residents, and fellows participating in military graduate medical educational programs and for junior attending physicians to build research relationships and experience. The offices of the Army, Navy, and Air Force surgeon generals should strongly consider creating career scientist awards for senior uniformed officers who are successful clinician-scientists, similar to the programs within other federal agencies.

CONSENSUS PROCESS

To ensure optimal treatment and rehabilitation of combat-related amputees, the medical and rehabilitation community has been in need of a "road map" to provide focus for efforts and priorities. With this mission in mind, Colonel Paul F Pasquina, MD, and Dr Rory A Cooper organized a 3-day symposium titled "Rehabilitation of the Combat Amputee—Consensus Conference and Creating a Roadmap for the Future," held at the Center for the Intrepid / Brooke Army Medical Center in Fort Sam Houston, Texas, on September 17–19, 2007. The event brought together VA, civilian, and military experts in amputee care, rehabilitation, and community reintegration to help establish consensus on standard-of-care issues, as well as to help identify areas most in need of further clinical, technical, translational, and developmental research. A total of 18 experts presented on current practice and knowledge during the symposium, including engineers, physiatrists, therapists, surgeons, historians, psychiatrists, neuropsychologists, neurologists, prosthetists, audiologists, and experts in pain management and veterans benefits. The speakers came from the VA, DoD, and universities, as well as private companies and institutions. The 100 to 120 symposium attendees formed five small discussion groups:

- programs and systems practices,
- surgical management and planning,
- special medical considerations,
- physical rehabilitation and therapeutic interventions, and
- prosthetic devices and assistive technologies.

Prior to the conference, attendees were asked to prepare manuscripts within their area of expertise that would be the basis for the chapters within this textbook. Each group was challenged to come to a consensus on critical items and management plans as outlined in each chapter. Furthermore, each group was tasked with forming a consensus for the most critical areas of investigation and research needed within their discipline to better meet the challenges of combat-related injuries, particularly those resulting in limb loss. The results are presented in the following section.

RESEARCH PRIORITIES

Outcomes Research and Cost-Effectiveness Studies

Consensus opinion highlighted the importance of outcome-related research. Specific outcomes of interest included programmatic issues, vocational rehabilitation, return-to-duty demographics, and the effects of therapeutic interventions. Participants identified the lack of well-designed longitudinal and retrospective epidemiological studies analyzing the incidence rates of amputation in combat casualties and the impact that etiologic and demographic data have on short- and long-term outcomes. In particular, factors such as level of amputation and extent of comorbidities should be examined to establish their impact on functional performance, quality of life, depression, return to duty/work/community, and healthcare costs, as well as acute and chronic pain. To effectively quantify the success of the treatment programs available to service members, better tools, especially for functional measures, must be designed. Additionally, the extent to which other comorbidities, especially cognitive or behavioral problems, have on outcome measures must be fully investigated. Because existing literature on best care practices is scarce, a process for making clinical decisions based on evidence-based studies must be better established.

The group also agreed that more research on vocational rehabilitation (VR) is needed. Although all healthcare professionals recognize the importance of recovery to the point of meaningful vocation, the best approach to VR intervention, as well as when during the recovery phase VR should begin, remain unclear. Additionally, tools to measure the effectiveness of VR interventions, as well as validated tools to evaluate community reintegration, should be developed. These tools will provide a framework for researchers to assess predictors of successful VR interventions. VR-related research should also investigate the effectiveness of rehabilitation technologies and explore barriers that may exist to return to military duty.

When an injured service member returns to active duty, it is important to establish a longitudinal registry to track information such as how long he or she remains on active duty and both the successes and difficulties that individuals experience. Data elements should include promotions, military awards, performance in military schooling, and attainment of advanced degrees, as well as possible subsequent related physical or psychological health problems. Keeping such a longitudinal registry of these individuals, including those who change military occupations, will allow further analysis of effective and ineffective paths to success. Furthermore, initial qualitative studies should be conducted to identify issues surrounding acceptance of an injured service member back into his or her unit and the perceptions of those in the recipient unit. These studies will help future generations determine who is more likely to return to successful active duty and what interventions could be made to help support greater success.

The consensus panel concluded that effective outcome research could not be conducted without a more uniformly standard way of providing case management to injured service members and their families. It was agreed that military and VA institutions have been inconsistent in counseling individuals. These inconsistencies have been compounded by the rapidly changing benefits system, which has made it increasingly more difficult for accurate and complete information to reach those who need it. More consistent case management should include appropriate structural organization within the DoD and VA, as well as standardization of the competencies required by each case manager. Educational materials also must be regularly updated and readily available for patients, families, and providers. Research studies should be conducted on evaluating the effectiveness of case management programs, and model programs should be replicated across the country.

As with other outcomes of interest, tools to measure the effectiveness of interventions, particularly in multimodal pain management, role of regional anesthesia, and integrated rehabilitation strategies for polytrauma care still need to be developed. Lastly, better outcome measures to assess the effectiveness of prosthetic components and technology, particularly as they relate to individuals with upper limb amputation, are needed to help physicians, therapists, and prosthetists better determine the device best suited for a particular individual.

Rehabilitation and Therapeutic Interventions

Very few longitudinal studies have been conducted on individuals with amputation, which has left significant gaps of knowledge for professionals attempting to determine how factors (such as demographics, health, and environmental factors) influence the use of a prosthesis and other mobility devices after amputation. This knowledge gap is especially wide for the cohort of active young service members with traumatic amputations, since most studies have focused on older, civilian patients with amputation related to vascular disease or diabetes. Significant

challenges also exist in examining the effectiveness of continually advancing technology. It is generally believed that advances in technology, particularly in prosthetic devices and wheelchairs, improve function, preserve the musculoskeletal system, and decrease energy expenditure over time, but it has been difficult to prove this scientifically. Recent studies advocate the use of prosthetic prescription models that take into consideration factors such as age, demographic characteristics, health, and behavioral-related factors in predicting successful prosthetic rehabilitation. These studies, however, do not take into consideration the functional performance levels often observed in young, otherwise healthy injured military service members. Nor do these studies take into account the importance attributed to a prosthetic device by the user, which undoubtedly has an impact on use and overall patient satisfaction.[1,2] Therefore, dedicated research is needed to inform innovative therapeutic approaches and advanced rehabilitation techniques for higher functioning younger amputees with the goal of returning to sports and military duty.

Consensus panel members identified the need to examine the impact of long-term prosthetic use in this unique patient population. To date, data has been lacking on overuse and repeated injuries related to prosthetic use. Unlike research on wheelchair-related technology, which has generated literature that strongly supports clear prescription guidelines for manual wheelchairs that preserve upper limb functioning,[3] similar data is lacking for prosthetic prescriptions. It is essential to look for findings of cumulative traumatic and overuse changes, both during the first year of prosthesis use as well as over subsequent years of long-term prosthetic use. This information will contribute to the development of early therapeutic and technological interventions to prevent excessive stresses on joints and the occurrence of chronic painful conditions such as low back and limb pain, which may lead to significant functional impairment and disability. It is equally important to objectively assess any occurrence of pathological changes on the nonamputated side from overuse, abnormal posture, or gait deviations to develop intervention protocol for preventing these secondary injuries.

Rehabilitation has traditionally been considered to involve a patient and his or her provider; however, interdisciplinary teamwork is becoming increasingly important for success, as has been demonstrated in the stroke literature.[4] Also, anecdotal evidence has been observed by the consensus group that family members, friends, and peer supporters have both positive and negative effects on rehabilitation outcomes. At each DoD amputee care program, family members are able to obtain local lodging, which allows them to participate directly in their loved one's care. In addition, a formal peer visitation program is well established at each DoD site, and all staff support and contribute to the therapeutic milieu. Further investigation, however, is needed to better understand the dynamics of recovery and how to best incorporate all parties into improving outcomes. Qualitative analyses, through interviews and focus groups with family members, could help in understanding their perspectives and potentially optimize their role in the recovery process of each service member.

Rehabilitation research on upper limb amputation was noted to be significantly lacking, particularly as compared to that on lower limb amputation. This is in part due to the complex nature of the rehabilitation process after upper limb amputation and the higher rejection and abandonment rate of upper limb prostheses. Research determining probabilities of upper limb prosthesis rejection, based on level of amputation and amputation of dominant versus nondominant upper limb, could be crucial for determining the course of the rehabilitation process and the prescription of particular prosthetic devices. The use of novel techniques such as metronome-based intervention was specifically mentioned as a potential means of improving body symmetry and postural control to aid in upper limb prosthetic rehabilitation. A study on differences of upper limb prosthesis acceptance based on hand dominance might drive protocols that address the inherent differences in a patient's acceptance and accommodation to use of a prosthetic device. With increasing use of functional magnetic resonance imaging and positron emission tomography, such a study could also include cortical scans to explore any difference in brain hemispheric activity based on hand dominance and prosthetic use. Other areas of potential research that may provide further insight on user preferences include investigating the effect of training variables, the patient's perceived benefit of the device, the quality and durability of components, and level of amputation. In summary, many research avenues should be explored within this new generation of upper limb amputees. Therapists working with this patient population should be diligent in seeking new knowledge to improve efficiency and minimize variability within care delivery methods.

As technology progresses, rehabilitation techniques and the sophistication of outcomes measurement tools must advance as well. All panel members agreed that systems such as motion analysis, kinematic and kinetic assessment techniques, and virtual-reality–based assessment and treatment modalities all warrant further development and clinical research funding.

Furthermore, systems that are able to acquire more real-time data on prosthetic usage, function, and effects on quality of life will be much more useful than the traditional patient recall methodology.

Advancement of Surgical Interventions

The consensus panel identified research priorities related to both acute and long-term medical and surgical care. Among those considered most important in the acute phase of care are optimizing surgical approaches and wound management strategies. Improving surgical techniques during the initial combat wound care as well as during the definitive amputation will have an impact on an individual's short-term recovery and likely positively influence his or her quality of life. Specific research emphasis should focus on techniques to improve peripheral nerve management associated with limb amputation to maximize sensory and motor function of the residual limb. Research is needed to evaluate the optimal way to manage sectioned nerves—for example, targeted reinnervation (see Chapter 27, The Future of Artificial Limbs)—which may reduce acute and chronic pain as well as improve future prosthetic control strategies. Also, data must also be collected to establish infection rates and investigate new methods of infection prevention and treatment. Furthermore, research is required to develop novel methods for wound management at all echelons of care. This should include investigation of various biomarkers and wound matrix analyses to better predict wound healing and optimize timing of surgical debridement, closure, or use of any bio-healing products.

Panel members reported a particular concern with the formation of prevalence of heterotopic ossification seen in war extremity trauma. Heterotopic ossification is the abnormal formation of bone that can limit joint range of motion and cause pain. A better basic science understanding of what turns on and off bone matrix formation is needed. Additionally, surgeons strive to optimize limb length, limb shape, and muscle/soft tissue balance. While a longer residual limb may provide increased function when an individual is not using a prosthesis, current prosthetics technology often requires extra space to accommodate more sophisticated components, and therefore in some circumstances a shorter residual limb may be desirable. Additionally, the residual limb shape needs to conform to the intended prosthetic device, adding another confounding factor. Likewise optimizing muscle length during attachment with either a myodesis or myoplasty may have a significant effect on residual limb muscle balance, strength, and function.

Considering residual limb bone management, participants did not reach a consensus about when bone-bridging techniques should be used in transtibial amputations. Some patients present with a divergent fibula because of injury to the syndesmosis or the proximal tibia–fibula joint, which may result in pain and/or hypermobility of the residual limb. Many bone-bridging techniques exist, but none have been proven superior because limited research data on functional outcomes following surgery is available. Additionally, the effect of timing (acute or revision) for bone-bridging procedures must be explored.

Panel members recommended that further research be conducted to explore the potential for and safety of osseointegration. Osseointegration is the direct skeletal attachment of a prosthesis to the residual limb, by implanting a metallic pin/buttress to the distal bone and allowing it to extend through the skin to connect with a prosthetic device. Current challenges include proper design, materials, surgical intervention techniques, and postoperative rehabilitation techniques. Emphasis should be placed on discovering methods to achieve direct skin growth/adherence to the metal implant to avoid infection, because combat wounds have an increased susceptibility to infection. Panel members agreed that if this technology becomes available it will likely revolutionize prosthetic fitting and require surgeons to change their current approach to residual limb-shaping procedures.

Advances in regenerative medicine may also have a significant impact on the medical and surgical management of amputees. Further investigation of composite tissue allografts and limb regeneration is necessary to explore the limits of this science and its application for injured service members. Additionally, further advances in peripheral vessel and nerve regeneration, grafting, and transplants may allow severely mangled limbs to heal to a point where amputation is not indicated.

Advancement of Medical Interventions

Polytrauma care for the combat amputee requires a complex medical treatment plan. Panel members noted that little is currently known about the neuroendocrine aspects of polytrauma care. Although the majority of combat-wounded soldiers are male, it is important to understand the effect of gender in healing and recovery. Specifically, research should be conducted to investigate the role that hormones, particularly testosterone, play in behavioral tendencies as well as healing following polytraumatic injuries.

Pain management was also cited as an important aspect of management needing further investigation.

Opioid use, in particular, which is often prescribed for pain management related to polytrauma, remains controversial because little is known about its short- and long-term effects on combat-wounded soldiers. Issues such as opioid-induced hyperalgesia have been reported, but little is understood about the pathophysiology of this phenomenon. Therefore, the safety and effectiveness of prescribing opioids for pain management needs to be assessed. Likewise, further investigation is needed to evaluate the effectiveness of other pain management techniques, including pharmacological and nonpharmacological treatments such as mirror treatment, acupuncture, therapeutic modalities, biofeedback, and electrical stimulation.

Residual and phantom limb pain often significantly impact the lives of combat-wounded amputees; however, little is known about what causes these phenomena or how to best treat them. Research efforts should focus on improving knowledge of the etiology and pathophysiology of residual and phantom limb pain. Further investigation should evaluate genetic predisposition to such pain syndromes as well as advanced neuroimaging and biological measures to achieve a more objective measurement of pain. Interventions such as regional anesthesia have been cited by the symposium's expert panel as extremely helpful in managing extremity pain syndromes and minimizing opioid use; however, further documentation is needed to translate these findings into everyday practice.[5] New diagnostic tests as well as novel treatments must be developed for these complex pain syndromes, and better data is needed to capture the incidence and etiologies of residual limb and phantom pain in this patient population.

Further needs identified include improved medical prevention and treatment of conditions such as venous thrombosis, pulmonary embolism, heterotopic bone formation, osteoporosis, and osteoarthritis. Additionally, treatment and prevention of other causes of long-term morbidity and mortality associated with major limb loss such as cardiovascular disease, hyperlipidemia, hypertension, peripheral vascular disease, and diabetes should be fully investigated. Such advances would benefit not only the combat-wounded amputee, but the general population as well. An additional area of research that has not yet been examined is the effect that comorbid TBI has on the rehabilitation and recovery of an individual with limb loss. Panel members reported up to a 60% incidence of brain injury in the combat amputee population. Although the majority of these cases are classified as "mild" TBI, it is likely that sequencing and training regiments could be optimized for these patients.

Support Programs

Multiple support groups and programs have been developed for injured service members. Programs such as Navy Safe Harbor, Marine Corps Wounded Warrior Regiment, Military Severely Injured Center, and Army Wounded Warrior (AW2) program have all been designed to assist wounded service members and their families. It remains unclear, however, how effective each of these programs are or how that effectiveness is being measured. Moreover, it is possible that multiple programs, while well-intended, may be adding to the confusion of patients and their families. Similar opportunities exist for recreational and sporting participation; however, it is unclear how to maximize the impact of these programs. Scientific methodology must be applied to these interventions to better understand their effect and document outcomes.

Technology

Advances in prosthetic design have led to greater emphasis on technology, which in turn has produced research priorities in this area. One of the most important of these questions is validation of these advanced designs. Research is needed to determine the best methods for validation. Once validation methods have been established, the efficacy of technologies can be objectively considered.

Future prosthetic research should include developing performance standards for prosthetic components and devices. The combat amputee population tends to be more active and is likely to participate in rigorous recreational activities, which must be considered when establishing these performance criteria. Another important consideration is that some members of this population will return to active duty. Prosthetic devices, therefore, must be able to perform at extremely high levels of function, reliability, and durability to prevent failure in the field or tactical environment.

Despite the great advances in prosthetic technology, more research and development is needed. Specific areas of interest include powered prosthetics, advanced robotics for manipulation, incorporation of artificial intelligence, and improved prosthetic–body interfaces. In addition to advancing the technology of prosthetic devices themselves, research should also focus on developing devices that may enhance the rehabilitation process. Specifically, systems that incorporate real-world simulations or virtual reality have great potential in this area. Novel systems such as the Computer-Assisted Rehabilitation Environment (CAREN [MOTEK Medical, Amsterdam, Netherlands]) should be further explored as a means

of providing multisystem rehabilitation training in a highly user-engaging fashion.

Efforts should also be made to incorporate advanced rapid prototyping technologies to the assistive technology (AT) prescription process. Technologies such as stereolithography, selective laser sintering, and three-dimensional scanners may allow for cost-effective manufacturing of small numbers of custom components. The ability to readily procure custom components would enable individualized solutions that may increase the usefulness of commercially available AT or fill a gap where no commercial product exists.

AT advancement may also help prevent secondary injuries. Studies examining the use of prosthetics in combination with wheeled mobility as a means of preserving intact joints, or the development of techniques to mitigate overuse of the upper extremities over time, may have a significant long-term impact on quality of life. Initial studies should examine current AT usage within the combat amputee population. This line of research would provide the answer to key questions, such as what types of AT are in use, how often these technologies are used, and whether AT is being used to it fullest potential.

Lastly, longitudinal studies should be conducted to assess how a user's need for technology changes over time. In all likelihood the types of AT used will change as this population faces decreasing function associated with aging. Research should be conducted to identify strategies for transitioning between types of AT. Studies of this nature could facilitate predictions for technology needs of this population, as well as provide insight into device adaption as users age. Additionally, methods of increasing access to AT must be established; programs should be established to increase awareness of available AT among both the end users and the clinicians who prescribe them.

Amputee Care Center of Excellence

A central lesson learned through the care of military service members during the global war on terror is the need to provide a coordinated system of care. At the core of this system should be an amputee "center of excellence" (ACoE), with a critical mass of healthcare professionals, research scientists, benefits coordinators, and strong leadership, including collaboration between VA and DoD and strong ties to academic institutions. Adequate resources are necessary to ensure the ACoE's success during war and in peace. These resources should include, but not be limited to, state-of-the-science research equipment and facilities, state-of-the-art clinical tools, diverse and talented staff, inclusion of activities for families, and a supportive environment for patients.

It is crucial that ACoE expertise be maintained as deployment and high operational tempos diminish. Although much has changed since earlier military conflicts, the experiences gained during World War II and Vietnam provided important insights. The postwar decision to disband and decentralize services should not be repeated. An ACoE would allow patients to continue being treated in sufficiently large groups to maintain interaction, provide a large enough cohort to advance research, and preserve an environment for clinical excellence. Ultimately, an ACoE will improve military and VA medicine while helping veterans with major limb amputations, who deserve the best that medicine and science have to offer.

SUMMARY

Armed forces' recruiting advertisements and slogans are designed to attract individuals of courage, commitment, and patriotism. Nowhere are these characteristics more evident than in the military amputee population. Hundreds of stories have been presented throughout the media across the globe illustrating the dedication and courage of injured American soldiers. In addition to the multiple stories in the press praising the work of the military medical community, the US DoD and VA are in unique positions to lead other countries and universities in the research and care of traumatic amputees. The ability of military and VA healthcare providers to pursue cutting-edge research in amputee care will foster a climate of enhanced job satisfaction across multiple medical, healthcare, and engineering disciplines. National and international recognition of the military and VA in this unique area of medicine and rehabilitation will also likely improve recruitment of medical specialists within the DoD medical departments and VA, but most importantly greatly contribute to the continued improvements in care delivery to the nation's heroes.

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