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PERSONNEL AND  
READINESS

The Honorable Mike D. Rogers  
Chairman  
Committee on Armed Services  
U.S. House of Representatives  
Washington, DC 20515

OCT - 3 2025

Dear Mr. Chairman:

The Department's response to House Report 118-529, pages 194-195, accompanying H.R. 8070, the Servicemember Quality of Life Improvement and National Defense Authorization Act for Fiscal Year 2025, "Improvements to Complex Wound Care," is enclosed.

This report provides an overview of Defense Health Agency (DHA) tissue regeneration products and related efforts. The current inventory includes 118 products specifically designed to enhance wound healing in various care settings and address diverse wound care requirements. The development of innovative tissue-based products is a fundamental aspect of the DHA's research strategy to advance complex wound care by furthering traditional treatment methods and introducing novel technologies to improve treatment effectiveness and recovery outcomes for Service members. Ongoing collaborations ensure these regenerative therapies are well-integrated across the Military Health System, supporting force readiness and the overall mission of the Department of Defense.

Thank you for your continued strong support for the health and well-being of our Service members.

Sincerely,

Sean O'Keefe  
Deputy Under Secretary of Defense for  
Personnel and Readiness

Enclosure:  
As stated

cc:  
The Honorable Adam Smith  
Ranking Member

# **Report to the Committee on Armed Services of the House of Representatives**



## **Improvements to Complex Wound Care**

**September 2025**

The estimated cost of this report for the Department of Defense (DoD) is approximately \$5,500 for Fiscal Years 2024–2025. This includes \$2,300.00 in expenses and \$3,300.00 in DoD labor.

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## **PURPOSE**

This report is in response to House Report 118–529, pages 194-195, accompanying H.R. 8070, the Servicemember Quality of Life Improvement and National Defense Authorization Act for Fiscal Year 2025, which requests that the Secretary of Defense provide a report to the House Armed Services Committee on improvements to complex wound care that addresses the following within the Defense Health Agency (DHA):

- (1) a comprehensive inventory of tissue regeneration products for wound care and methodologies currently employed in DHA facilities;
- (2) a summary outlining the stocks of tissue regeneration products within the medical stockpile, storage requirements for those products, supply chain limitations, surge capacity, and quantification of products lost to expiration or storage issues;
- (3) a summary outlining the source materials of those products, the religious considerations when using those source materials, and the environmental impact of such materials;
- (4) an evaluation of the cost-effectiveness and efficacy of adopting fish skin grafts compared to conventional methods;
- (5) updates on ongoing research and development endeavors about tissue-based products for wound care, including fish skin grafts, within the DHA;
- (6) insights into the training programs offered to medical personnel for the appropriate application and utilization of fish skin grafts; and
- (7) information on existing research initiatives, collaborations, or partnerships with external entities to advance tissue-based technologies for wound care.

## **BACKGROUND**

Under the direction of the Office of the Assistant Secretary of Defense for Health Affairs, DHA administers the Defense Health Program Research, Development, Test, and Evaluation appropriation with the objective to develop and enhance medical capabilities for current and emergent needs of the military community. This includes research in complex wound management and tissue-based product innovation, which are critical for improving recovery outcomes and enhancing Service member readiness.

## **COMPLEX WOUND CARE AND TISSUE REGENERATION IN THE DHA**

DHA’s Combat Casualty Care and Musculoskeletal Injury portfolios have included the development of innovative tissue-based products as a fundamental aspect of their respective Strategic Research Plans to improve complex wound care and tissue regeneration. These products not only aim to enhance traditional treatment methods but also introduce groundbreaking technologies that could redefine therapeutic approaches within military and civilian medical practices.

## **METHODOLOGIES IN CLINICAL DECISION-MAKING**

Clinicians employ a case-by-case methodology when selecting treatments and products for wound care. Key considerations include:

- Food and Drug Administration approval status;
- Patient's medical conditions influencing outcomes;
- Expected recovery timelines;
- Projected outcomes and cost implications; and
- Treatment scalability and literature support.

This nuanced decision-making parallels the selection of implants or grafts in surgical procedures, leveraging clinicians' experience, skill, and knowledge to ensure the best possible patient outcomes, based on the patient's presentation. The absence of a fixed algorithm underscores the importance of personalized care in wound management.

### **Element (1): Inventory of Tissue Regeneration Products**

The current Military Health System (MHS) inventory includes a range of available products specifically designed to enhance wound healing in various care settings. This catalog encompasses advanced solutions such as bioengineered tissue matrices, collagen-based wound coverings, and regenerative scaffolds. The range of products address diverse wound care requirements from minor injuries to complex, chronic wounds requiring specialized materials. Table 1 lists the categories and subcategories (where applicable) of the tissue regeneration products currently in the MHS inventory and includes a brief description of each product type.

**Table 1. Categories of Tissue Regeneration Products in Current MHS Inventory**

<b>Product Category</b>	<b>Product Subcategory</b>	<b>Description</b>
Cellular and/or Tissue-Based Products	Acellular Matrix	Acellular matrices are derived from sources other than human skin. All are composed of allogenic or xenogenic derived collagen, membrane, or cellular remnants intended to stimulate or exaggerate the characteristics of human skin.
	Allogenic Matrix	Allogenic matrices are usually derived from human neonatal fibroblasts that may contain metabolically active or regenerative components primarily used for soft tissue support, though some have been approved for the treatment of full-thickness skin and soft tissue loss. This category also includes cellular and/or tissue products derived from amnion, chorion, placenta, or umbilical cord that have not been decellularized.
	Composite Matrix	Composite matrices are derived from human keratinocytes and fibroblasts supported by a scaffold of synthetic mesh or xenogenic collagen. Active cellular components continue to generate bioactive compounds and protein that may accelerate wound healing and epithelial regrowth.
	Human Skin Allograft	Human skin allografts are bioengineered from human skin components and human tissue which have had intact cells removed or treated to avoid immunologic rejection. They are available in different forms to allow scaffolding, soft tissue filling, growth factors, and other bioavailable hormonal or enzymatic activity.
Synthetic Matrix	N/A	Synthetic skin substitutes are constructed from non-biological molecules and polymers that are not normally found in skin.
Growth Factors	N/A	Recombinant growth factors are proteins (polypeptides) that occur naturally in the body and are integral in the wound healing process. Research findings reveal that they stimulate cell growth and migration. They are manufactured through recombinant deoxyribonucleic acid (DNA) technology.
Hydrogel	N/A	Hydrogel wound dressings are three-dimensional networks of cross-linked hydrophilic polymers that are insoluble in water and interact with aqueous solutions by swelling. This category includes hydrogels that are of synthetic or natural origin.

## Elements (2) and (3): Summary of Tissue Regeneration Product Stock and Stock Materials

A total of 118 products aligned under the seven categories or subcategories (where applicable) listed in Table 1 have various regulatory approvals with Healthcare Common Procedure Coding System Level II codes to identify products, supplies, and services rendered in military medical treatment facilities (MTFs). Table 2 provides the total number of tissue regeneration products for each of these seven tissue regeneration product categories or subcategories.

**Table 2. Number of Tissue Regeneration Products by Product Category or Subcategory**

<b>Product Categories/Subcategories</b>	<b>Number of Products</b>
Acellular Matrix	41
Allogenic Matrix	45
Composite Matrix	1
Growth Factor	1
Human Skin Allografts	11
Hydrogels	11
Synthetic Matrix	8
<b>Total</b>	<b>118</b>

Regarding source biomaterials used for biomanufacturing, the majority of tissue-engineered skin or organ products are derived from either adult stem cells or immortalized human adult cell lines. Most religious objections to cell and tissue therapies relate to the use of fetal tissue. However, many products have successfully shifted from using fetal tissue as a source due to advances in this field. Table 3 lists the total number of products by source material.

**Table 3. Total Number of Products by Source Material**

<b>Source Material</b>	<b>Number of Products</b>
Biosynthetic	1
Bovine	9
Bovine/Human	1
Combination	3
Equine	1
Fish Skin	8
Human	62
Keratin Derived from Ovine Wool	1
Ovine	1
Porcine	14
Recombinant Platelet-Derived Growth Factor (rPDGF)	2
Synthetic	15
<b>Total</b>	<b>118</b>

A review of the medical stockpile highlights that most tissue regeneration products require specific storage conditions. While many are shelf-stable, some products demand cold chain logistics to maintain their effectiveness, with storage temperatures varying based on the biological composition of each item. Supply chain limitations for these items often stem from sourcing constraints and logistical challenges, particularly for cold chain-dependent products. Surge capacity is designed to meet increased demand but may be limited by product shelf life and procurement lead times. Historical stock attrition indicates that a small percentage of products are lost due to expiration or storage issues, especially those requiring strict temperature control, underscoring the need for precise inventory management to minimize waste.

The source materials for these products are primarily derived from animal-based collagen, synthetic polymers, and sometimes human-derived biomaterials, each selected for their regenerative properties. Using animal-derived products, especially those containing bovine or porcine collagen, requires awareness of religious considerations, as some patients may prefer alternatives based on their beliefs. DHA actively considers these factors to accommodate individual patient needs, especially in settings allowing substitution with synthetic or plant-based alternatives without compromising care quality. Additionally, the environmental impact of these materials is considered, especially for synthetic products which often involve plastic polymers. DHA has initiatives in place to explore sustainable alternatives where feasible, seeking materials that align with environmental goals while meeting clinical efficacy standards.

In summary, DHA's complex wound care product catalog is a robust, meticulously managed inventory aimed at addressing both the immediate and long-term needs of military healthcare providers. Through diligent sourcing, storage management, and sensitivity to ethical and environmental considerations, DHA ensures its stockpile of regenerative products remains resilient, effective, and responsive to both clinical and cultural needs.

#### **Element (4): Cost-Effectiveness and Efficacy of Adopting Fish Skin Grafts**

Biologic skin substitutes are an integral option in the treatment plan for patients to provide wound healing. Fish skin grafts have demonstrated greater effectiveness in achieving complete wound ulcer healing than conventional standard of care (SOC) options. Cellular and/or tissue-based wound treatment(s) have become increasingly popular over the last 20 years, resulting in the availability of multiple options (Zehnder & Blatti, 2022). Availability can be based on price, physician preference, patient characteristics, wound healing properties, and/or established professional SOC.

In 2013, the Food and Drug Administration approved decellularized fish skin for use as tissue-regeneration material to accelerate wound healing and tissue reconstruction. In clinical use, this product has promoted healing in chronic foot ulcers. A systematic review and meta-analysis found that fish skin grafts have been demonstrated to be more effective in achieving complete ulcer healing compared to current SOC treatments for diabetic foot disease while noting that fish skin grafts are more cost-effective than current SOC options in these cases (Muñoz et al., 2024). The unique properties of fish skin grafts allow the product to adhere well to the wound bed, limit the number of dressing changes required, and promote the wound bed, thereby facilitating accelerated healing (Muñoz et al., 2024). Findings from this study suggest

that fish skin grafts can be considered as the first choice treatment to achieve ulcer closure and healing in patients with diabetic foot ulcers (Muñoz et al., 2024).

An outcome-based pricing model study was conducted by a Swiss hospital to prospectively examine venous and diabetic wounds treated by SOC methods or fish skin graft methods. Findings suggest that even though the fish skin graft products were initially more expensive than SOC, their use decreased the length of hospital stays, resulting in cost savings over the long term (Zehnder & Blatti, 2022). Chronic wounds, which often require these methods of treatment, present a financial burden on healthcare systems. Therefore, it is of interest to have wounds treated promptly and properly. The results of this study demonstrated that treatment with fish skin grafts promoted faster wound healing than predicted rates from SOC treatment options. The relative time to heal and wound size were studied for SOC treatments, SOC combined treatments, and fish skin grafts (Zehnder & Blatti, 2022). Fish skin grafts significantly reduced healing time and wound size in the wound area, resulting in cost savings (Muñoz et al., 2024).

In conclusion, it is optimal that fish skin grafts remain an option for treatment selection within the MHS. Though the ability of fish skin grafts to enhance wound healing is scientifically proven, evaluations on the potential cost savings based on decreased surgical procedures and length of hospital stays have not been conducted to establish the overall financial burden from the initial purchase of graft materials.

**Element (5): Ongoing Research and Development Endeavors**

DHA reports 65 ongoing tissue regeneration research projects targeting wound healing summarized in Table 4 below.

**Table 4. Number of Ongoing Tissue Regeneration Research Projects by Targeted Tissue**

Targeted Tissue Type	Number of Ongoing Research Projects
Combination	13
Connective Tissue	24
Nerve	7
Organ	3
Skin	18
<b>Total</b>	<b>65</b>

These ongoing tissue regeneration efforts are advancing innovative therapies for various tissue types, including skin, muscle, bone, and nerve repair. For skin regeneration, strategies include preventing partial-thickness burns from worsening; using fish skin as a bacterial barrier for deep wounds; and using an automated device that harvests and implants full-thickness skin microcolumns in burn wounds to accelerate the healing process and reduce the need for surgery. Muscle restoration involves use of the following two synergistic approaches: 1) decellularized muscle fibers as injectable therapies to improve shoulder function after rotator cuff injury; and 2) off-the-shelf muscle constructs to restore pelvic floor mass and function. Bone regeneration efforts focus on a tissue-engineered graft with a microvascular sheet designed to enhance early

blood flow and integration into the host tissue. Additionally, a study on dental bone healing aims to improve outcomes for tooth socket injuries. For nerve repair, a nerve guide bridges long nerve gaps, supplemented by extracellular vesicles to stimulate muscle regeneration downstream. Collectively, these innovative regenerative therapies intend to enhance both military and civilian medical outcomes, particularly in the treatment of severe injuries, burns, and trauma.

#### **Element (6): Training Programs for Fish Skin Grafts**

Programs like the Department of Defense (DoD) Emergency War Surgery Course establish combat training competencies and coordinate training to develop and sustain trauma surgeons located in operational environments, MTFs, or at Level I trauma treatment facilities. Training includes multiple surgical techniques to provide definitive soft tissue coverage, such as basic flaps and tissue advancements, burn management, skin grafts, and advanced local techniques. There is no additional training reported for the use of fish skin grafts in wound healing and tissue regeneration treatments, as they do not differ significantly from SOC grafts with respect to storage, reconstitution, and application.

#### **Element (7): Summary of Existing Research Initiatives, Collaborations, or Partnerships**

Established in 2008, the Armed Forces Institute of Regenerative Medicine (AFIRM) is a consortium of academic laboratories and industry partners that funds research to minimize the risk of technologies and accelerate the translation of regenerative medicine into clinical practice. The AFIRM supports research on the use of regenerative medicine in the following six current focus areas:

- Craniofacial regeneration;
- Extremity regeneration;
- Genitourinary/lower abdomen;
- Skin and wound healing;
- On-demand blood; and
- Cellular therapies for trauma.

The treatment of burn wounds presents unique challenges, particularly in operational settings where rapid and effective care is critical. Recognizing these challenges, DHA conducted an Analysis of Alternatives (AoA) under Medical Product Research and Development (MPRD). This analysis aimed to identify innovative and effective alternatives to traditional treatments such as autografts and allografts which often involve considerable recovery times and risk of complications.

MPRD AoA Key Insights: The AoA documented 27 viable treatment alternatives, categorized into the following 4 main groups, each of which represents a strategic approach to enhance burn treatment outcomes:

- **Tissue Products and Grafts**: These include novel biologic grafts such as fish skin, which has shown efficacy in accelerating the healing process and reducing infection rates when applied to burn wounds.
- **Engineered Autologous Cellular Products**: These treatments are developed from cells harvested from a patient's own body, thereby reducing the risk of rejection and improving integration, which renders them specifically essential for treating severe burns where rapid tissue regeneration is critical.
- **Engineered Allogeneic Cellular Products**: Offering the benefit of scalability and immediacy, these treatments use donor cells processed to minimize immune response, making them suitable for acute care in battlefield conditions.
- **Engineered Acellular Matrices**: These scaffolds support tissue regeneration by facilitating the integration of the body's cells into the damaged area, which is particularly useful for treating extensive burns where traditional grafts might not be viable.

## **CONCLUSION**

DHA's Strategic Research Plans identify and prioritize initiatives to improve and enhance complex wound care and tissue regeneration to fulfill a crucial component of DHA's commitment to enhancing medical treatment for Service members. In addition, the MHS inventory includes a range of available products, such as bioengineered tissue matrices, collagen-based wound coverings, and regenerative scaffolds, specifically designed to enhance wound healing in various care settings. DHA's complex wound care product catalog provides access to products that address the immediate and long-term needs of military healthcare providers. DHA aims to improve treatment effectiveness and recovery outcomes. Ongoing collaborations within DoD and with civilian sector and academia partners ensure these technologies are well-integrated across the MHS, providing significant benefits to Service members and supporting the overall mission of DoD.

## REFERENCES

- Ruiz-Muñoz, M., Martínez-Barrios, F. J., Cervera-Garvi, P., Lopezosa-Reca, E., & Marchena-Rodríguez, A. J. (2024). Fish skin grafts versus standard of care on wound healing of chronic diabetic foot ulcers: A systematic review and meta-analysis. *Primary Care Diabetes*, *18*(3), 291–298. <https://doi.org/10.1016/j.pcd.2024.03.008>
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