

Tulane engineering students place first in design competition

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Brian Layman, center, a prosthetist/orthotist at Southeast Louisiana Veterans Health Care System served as an advisor to Tulane biomedical engineering students, from left, Carly Harad, Marjie Williams, Kali Dancisak and Ava Heller. (Photo by Paula Burch-Celentano)

When four biomedical engineering students from Tulane University were chosen for an internship at the Southeast Louisiana Veterans Health Care System (SLVHCS) last

summer, they were tasked with identifying an unmet clinical need – something that would not only save money for the agency but improve patient care and satisfaction.

They brainstormed multiple ideas, ultimately settling on a project they dubbed “Socket To Me” — improving the costly and time-consuming process of manufacturing lower limb prosthetic sockets.

With a grant from the National Institutes of Health, they spent the summer transforming their idea into an actual design — a winning design.

At the SLVHCS’s recent Performance Excellence Fair, the team of Kali Dancisak, Carly Harad, Ava Heller and Marjie Williams, won first place out of more than 40 department entries. Judging was based on such factors as patient outcomes and satisfaction, cost-effectiveness, increased workforce efficiency and engagement.

The recognition came with a trophy and a \$10,000 prize, which through the Orthotics and Prosthetics Department at the SLVHCS will be used to further develop the design.

“We are ecstatic that our project was awarded first place,” Harad said. “We are proud of our accomplishments, particularly the positive impacts we have had on the veterans and the clinicians providing care.”

Under the guidance of the SLVHCS’s Brian Layman, the team spent the summer of 2020 working alongside prosthetists, orthotists and physical therapists as part of a collaboration with Tulane’s biomedical engineering department.

“Every summer we have a new group of BME students participate in our summer program to help them understand some of the obstacles when designing custom orthotic and prosthetic devices,” said Layman, a certified prosthetist/orthotist with expertise in 3D printing prosthetics. “Understanding patients’ needs and limitations are always unique to the patient, which make designing custom devices challenging and rewarding.”

The Tulane project aimed to assess the potential cost and efficiency benefits of digitizing the prosthetic socket workflow by integrating 3D scanners, 3D printers, and CAD (computer-aided design) software. “To achieve this, we conducted a case study with the goal of improving patient point of care, determined by increasing time efficiency and decreasing costs,” Heller said.

Using both manual and digital methods, they fabricated below-knee prosthetic check sockets, a critical component that serves as an interface between a patient's residual limb and the prosthetic device. It is also the preliminary step used to perform an initial assessment before the final socket is manufactured.

The students compared the manual and digital processes and concluded that the digitizing below-knee prosthetic check sockets saved time and money.

"This means that they (clinicians) can manufacture multiple sockets at once and spend more time with patients," said Williams.

The team said further studies would be necessary to validate the results and assess the long-term cost savings. "In the future, we hope to calculate the number of patients that need to be treated in this fashion for the savings effect to be seen," Dancisak said.

They will continue to do just that, with the two seniors in the group incorporating what they learned over the summer into their year-long capstone design project. In addition, three of the team members are continuing to work at the SLVHCS to sharpen their skills and prepare for life post-graduation, be it finding a job in the health care industry or working toward their master's degree in biomedical engineering.

All four agreed that the SLVHCS internship, coupled with their biomedical engineering studies, has been an invaluable part of their Tulane experience.

"I have a strong desire to help others and improve clinical outcomes," Harad said. "Biomedical engineering allows me to apply my technical knowledge to design and develop innovative products and directly impact patient lives."

She and her teammates got a taste of that through their work at the VA. "My favorite part of my experience so far is the smile my work brings to patient faces," Harad said. "I am motivated by the happiness and positive impact my work has directly on patient's lives."

Socket to Me

Prosthetics and Orthotics Department

Problem: The manufacturing process of lower limb prosthetic sockets is costly and time consuming.
Goal: Improve patient point of care through the integration of 3D scanners and printers.
Method: Two prosthetic socket workflows were analyzed using one patient to maintain consistent geometry.

Data Acquisition

➔

Modification

➔

Manufacturing

Casting

Traditional casting requires the practitioner to wrap the limb in fiberglass. Once it has hardened, the cast may be removed from the limb.

Scanning

The PVA Structure Scanner is utilized to capture a 3D digital image of the patient's residual limb. Tracer dots optimize the process for a better overall scan.

Plaster

Plaster is then mixed and poured into the cast and left to dry. The final product is a plaster mold of the residual limb.

Software

Using the PVA Rapid Plaster software, a scan can be smoothed, have buildups created, or have spaces carved for a more secure fit.

Bubble Pull

A thermoforming heated sheet of plastic is pulled over the plaster mold and a test socket is shaped.

3D Printing

A PVA Emergence Pro 3D printer, is utilized to print a socket out of PETG/PCTG plastic.

| | Casting | Scanning | Savings | | Plaster | Software | Savings | | Bubble Pull | 3D Printing | Savings |
|-------------|-----------|----------|---------|-------------|-----------|----------|---------|-------------|-------------|-------------|---------|
| Time | 11.58 min | 6.1 min | 47% | Time | 78.65 min | 15 min | 81% | Time | 85.5 min | 20 min* | 77% |
| Cost | \$26.60 | \$6.00 | 77% | Cost | \$10.50 | \$0.00 | 100% | Cost | \$28.39 | \$4.18 | 85% |

- 3D printing only requires **20 minutes of practitioner time** per socket
- Benefits for patients: reducing amount of required visits
- Benefits for clinicians: allowing for more time with patients
- Benefits for the administration: results in **cost and time savings**

*Active run time is ~180 min (unattended)

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Carly Harad, Tulane senior

